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A GEOGRAPHIC STUDY IN SHIZUOKA PREFECTURE, JAPAN[1]

GLENN T. TREWARTHA*

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[1]The materials for writing this paper were collected in the field and from statistical volumes thru the medium of Japanese interpreters. The writer was barred by the formidable barrier of language from making direct personal contact with original sources of information which has prevented him from checking and verifying the accumulated evidence as carefully and thoroughly as he wishes might have been the case.

*John Simon Guggenheim Fellow for Geographic Research in the Far East, 1926-1927. The present monograph is a report on one of a series of field studies in the Orient resulting from this fellowship.

INTRODUCTION

Cultural and natural features of Japanese landscape in contrasting and multiple forms are present in an abundance in Shizuoka Prefecture such as can scarcely be duplicated in any other equal area in Japan. Rugged sedimentary rock mountains and symmetrical volcanic ash cones; uplifted ancient delta-fans now appearing as flat topped terraces; low delta-fans of recent alluvium with sandy outer margins, and coastal waters teeming with marine life, and each of these major forms of the natural landscape presenting a variety of subforms, are here found in such close juxtaposition that a study of Japanese habitation in diverse local environments is areally concentrated (Figs. 1 and 2).

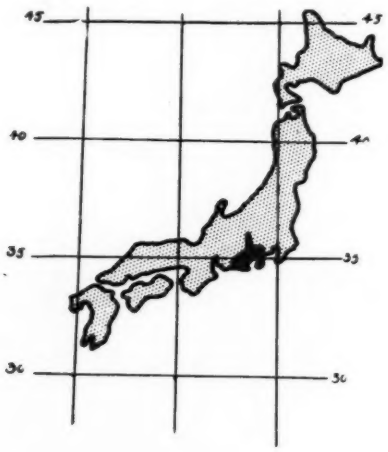

FIG. 1—Shizuoka Prefecture shown in black. Note that it is crossed by the 35° parallel. It is nearly midway between Tokyo and Yokohama on the north and Osaka and Kobe on the south.

No less manifold than the natural features are the cultural landscape forms by which man through his works has succeeded in making his imprint upon the area. Typical of Japan as a whole, Shizuoka is predominantly rural and agricultural, but not to the exclusion of the manufacturing and commercial industries which in a few localities support urban communities of relatively large size. The two most famous thoroughfares of the country, the Tokkaido National Highway and the Tokkaido Railway, the former of century-old fame, which cross Shizuoka from west to

east, testify to its strategic corridor position almost midway between the ancient political and the present urban and industrial centers of the Empire. More so than in most parts of Japan, agriculture has advanced to a commercial stage of development and in a number of districts specialization in certain crops has

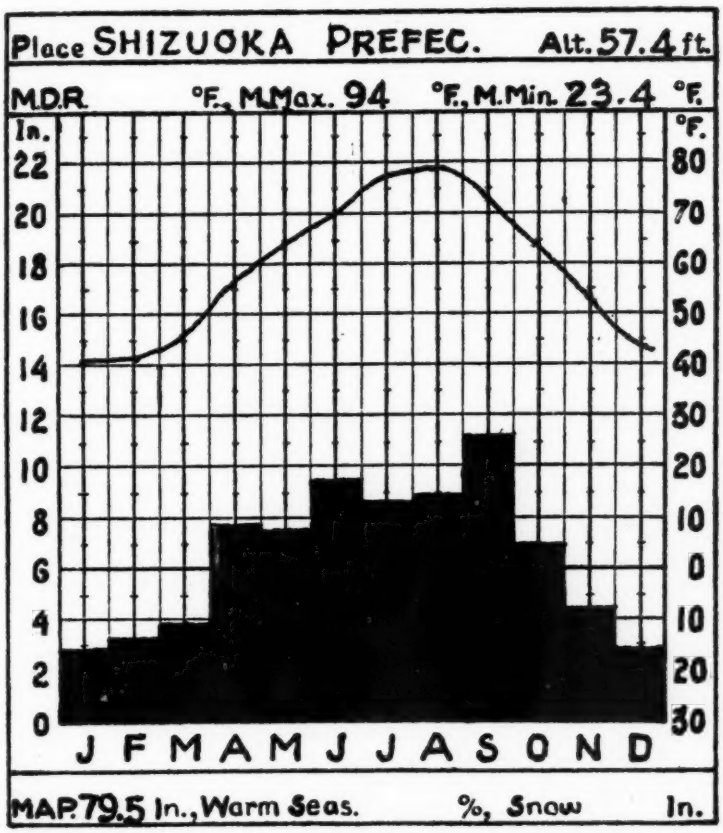

FIG. 2—Composite graphs showing the temperature and rainfall characteristics of Shizuoka Prefecture. In Koppen's scheme of classification it is designated as a "Warm, Temperate, Rainy Climate" (Cfa).

been carried to such a high degree of attainment that not only a national, but even an international, reputation has been established. On the terrace uplands and the mountain foothills are produced in abundance two crops which have carried the fame of Shizuoka

not only to all parts of the Island Empire but beyond the seas to foreign marts as well, for tea and oranges from this province enter into foreign trade in quantities not equalled by any other prefecture in Nippon. In Japan the name Shizuoka is synonymous with tea; the economic structure of the province is in a measure dependent upon this crop, for within its borders are grown nearly one-half (forty-eight per cent in 1925) of the nation's tea, and ninety to ninety-five per cent of its exported product.[2]

The domestic renown of Shizuoka is not confined to oranges and tea. The resources of its coastal waters have been developed to the point where only Hokkaido outranks it in value of marine products. On its delta-fans sufficient area has been wrested from the monopoly of paddy rice to permit the maximum development of native pears anywhere in Japan, while the sandy outer margins of the delta-plains are specialized truck and market gardening centers.

It is this extraordinary concentration of diverse and interesting varieties of Japanese natural and cultural landscape forms, together with the fact that here is the major center of one of Japan's great commercial crops and several of lesser magnitude, as well as an important focus for a number of manufacturing industries, which makes Shizuoka so attractive and profitable as a region for geographic field study.

THE MAJOR LINEAMENTS OF THE AREA

The area under consideration in this study includes practically all of Shizuoka Prefecture excluding the Izu Peninsula, a barren, mountainous southward projection of the Fuji Range which geographically may be properly omitted from the discussion. The western boundary of the area is Hamana Lake which approximates, but is not quite identical with, the somewhat artificial political boundary. Mountains closely border Hamana Basin along its northern margin thus making the western frontier complete as well as natural, and forcing the Tokkaido Railway and Highway,

[2] *Annual Report of the Department of Agricultural and Forestry*, 1925 (In Japanese). Section of Statistics, Ministry of Agriculture and Forestry, Japan, Tokyo, 1926. Table 17, p. 50. Figures are not available to show what percentage of the tea exported abroad is grown in Shizuoka Prefecture but for the season 1927 approximately ninety-seven per cent of the export was embarked at the port of Shimizu in Shizuoka and it is safe to assume that nearly that amount of the total export originated within the prefecture.

those trunk thoroughfares of the Pacific coast of Japan, to pass south of the lake along the spits which are gradually shutting it away from the sea, and over a long bridge whose piles are sunk in the shallow waters which cover the bar at its mouth.

The area studied is terminated on the east by that same mountain barrier, the Fuji Range, which is responsible for the Izu Peninsula and which interposes the most serious topographic barrier along the entire Tokkaido Railway between the "Kwanto," or Tokyo—Yokohama region in central Honshiu, and the "Kwansai" district farther south, with Nagoya, Kyoto, and Osaka as representative cities. The ancient names, Kwanto, or "east of the barrier" and Kwansai, "west of the barrier," testify to the significance of this topographic obstacle and to the impression which it made upon travelers in the days of litters and pack-animals. Even in these times of modern transport, continuous toll is still paid to the mountain, for the Tokkaido Line, one of the two double tracked railways in Japan, bearing as it does the extraordinarily heavy traffic between the two most populous and highly industrialized sections of the country, crosses the barrier by a circuitous route, replete with steep grades and numerous tunnels.

Henceforth in this paper the term Shizuoka will be understood to include only that part of the prefecture lying between the boundaries just previously described, an area approximating 2000 square miles in extent with a sea frontage of probably more than one hundred miles.[3] Although the region has natural limits it is not contended that it is a distinct geographic unit.[4] In a more real sense Shizuoka is a sample of a variety of landscapes rather than a geographic entity and it is this characteristic which the present study prefers to emphasize.

The geomorphologic pattern of the island of Honshiu, with its thick core of mountains and its narrow and discontinuous perimeter of coastal terraces and alluvial lowlands, is duplicated in a large number of its prefectural subdivisions, including Shizuoka, for their boundaries have been drawn so as to include samples

[3]The area can be further circumscribed 50 per cent or more by eliminating a large part of the mountain country, a region quite uniform in its habitat characteristics and only studied in sample areas adjacent to the coast.

[4]See K. Tanaka, "Geographic Units of Japan" (In Japanese) in *The Geograpical Review* of Japan, Vol. III., No. 1, January 1, 1927, pp. 1-21 with maps.

of both the fruitful plains and the less habitable mountains. Even the minor political subdivisions of Shizuoka Prefecture, or "gun," have a similar arrangement, for in a majority of cases their long axes are perpendicular to the seacoast so that within a gun, sea

FIG. 3—The major land forms of Shizuoka Prefecture.

frontage, plain, and mountain are none of them lacking. This arrangement of boundaries is testimony to the complementary nature of these land forms in the Japanese system of rural economy.

Shizuoka Ken,[5] therefore, with its hinterland of relatively high mountains whose coastal margins are fringed with fragments of alluvial terraces, and numerous less elevated delta-fans of recent alluvium, presents a representative cross section of Japanese land

[5] "Ken" is synonymous with "prefecture."

forms. In some parts several deltas coalesce to form a semi-continuous coastal plain; in others the mountain wall closely parallels the seacoast so that alluvium is entirely lacking; while in still other sections radiating spurs of mountain or terrace tend to isolate partially or even completely the individual delta-fans.

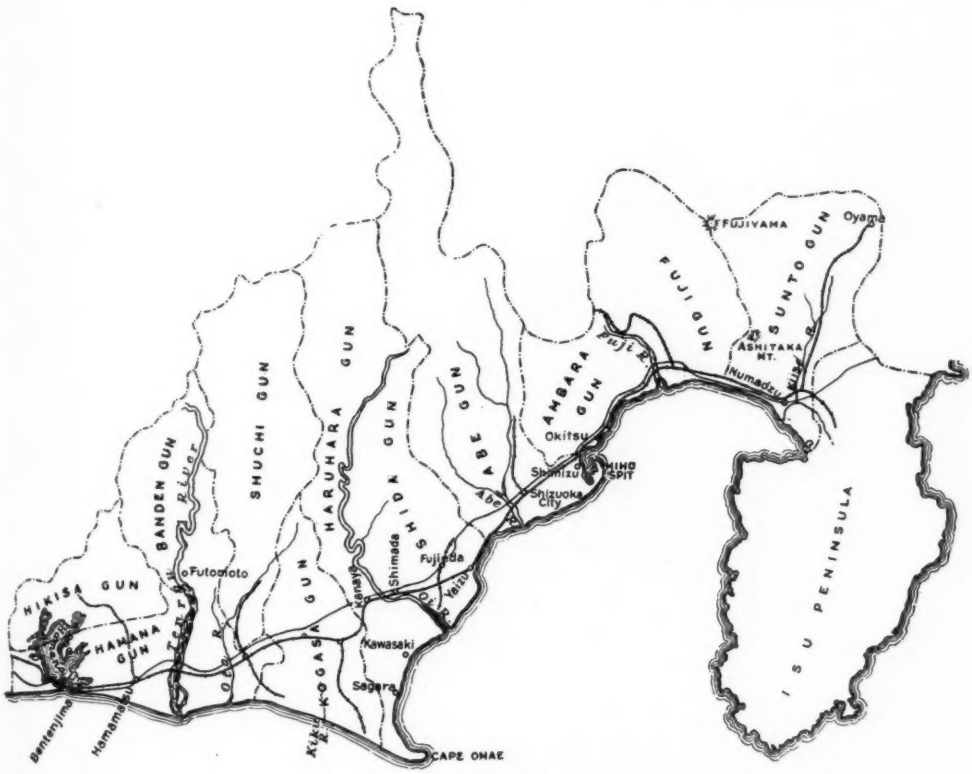

FIG. 4—Outline map of Shizuoka Prefecture, showing political subdivisions, lines of communication, location of cities, etc.

Here and there on the plains detached remnants of mountain and terrace, outliers both physically and culturally, rise prominently above the sea of alluvium which surrounds them (Fig. 3).

The mountainous hinterland of Shizuoka, which by a rought estimation appears to occupy two-thirds to three-fourths of the ken's area, includes on its eastern margin the lofty, symmetrical ash

cone of Fuji and that of its older and more furrowed satellite, Ashitaka, whose intensively cultured lower slopes approach to within a mile of the sea. Much the larger segment of Shizuoka's mountain mass, however, is composed of deformed sedimentary strata, sandy shales for the most part, wherever the author has seen them, deeply carved into a sharp, angular type of landscape by the vigorous streams fed from the abundantly watered slopes.[6] Only along the outer margins of the mountain province adjacent to the populated plains, as on slopes similarly located with respect to inhabited mountain valleys, have these regions of steep gradients and thin soils been brought under intensive cultivation. The woodland cover, which mantles extensive areas in the mountains, makes the chief contribution to man's well-being, but many slopes, potentially forest land, are covered with only a matting of coarse wild grasses and deserve the name of waste land.

Physiographic unconformities and " geographic unconformities " are usually abrupt in Japan, there being a lack of easy and gradual slope and culture transitions such as we are accustomed to in regions of moderate relief in the United States. In this respect Shizuoka is likewise the rule rather than the exception. In many places the steep mountain slopes with their distinctive mantle of wild grass, timber, or unirrigated crops, dip at a sharp angle into the flat, alluvial paddy lands, but sometimes the descent is broken by an intermediate step down to sand and gravel terraces, which are remnants of ancient flood plains, alluvial fans and deltas. Streams have in places carved wide valleys thru these elevated, fluviatile deposits, subsequently depositing in the valleys and beyond them the recent alluvium which now forms the delta-fans.

The terrace uplands are without doubt the most striking forms of the physical landscape in Shizuoka Prefecture. They rise from the alluvium by steep slopes, and not infrequently by almost perpendicular walls, to elevations of several hundred feet, their exposed sides exhibiting for the most part poorly assorted sands, gravels, and bowlders, occasionally found cemented together into a rather compact matrix. In spite of vigorous erosional agencies which have succeeded in carving the flanks of some of the terraces into a labyrinth of sharp, angular ridges and valleys, often grass

[6]Stations on the lowlands have eighty inches of precipitation and the amount is probably greater in the mountains.

or tree covered, there are normally still preserved at the summits, remnants of the original flat depositional surfaces, so that from a distance these land forms can quite commonly be distinguished by their even crests or sky lines. A relatively thick veneer of rust colored volcanic ash, a subaerial or shallow-water deposit, almost invariably mantles the terrace sands and gravels on these upper surfaces, providing thereby a soil cover which supports an intensive agricultural régime. Lacking as they are in irrigation water, either because of the absence of surface drainage, or the canyon-like nature of the valleys in which the streams flow, these uplands are not considered as desirable as the delta-plains in a country where the cultivation of paddy rice is something of an obsession, and consequently they are not always as completely and intensively utilized as one might expect. Tea gardens, the most extensive anywhere in Japan, are the premier form of culture on the relatively smooth and flat upper surfaces of the terraces, but relatively large areas are likewise devoted to mulberry, summer vegetables, winter grains, and orchards. The dissected flanks are sometimes artificially terraced to support a culture identical with that of the upland surfaces, but more frequently they bear a protective covering of timber or wild grasses. The relative inaccessibility of the top surfaces of the terraces has reacted against their development as sites for villages, or even numerous individual dwellings. Thus it happens that their exploitation is largely in the hands of agriculturists who are cultivators of rice, residing on the plains.

It is on the delta-fans of the Tenryu, Oi, Abe, Fuji, and other smaller streams, where irrigation water is available, that life is concentrated. This is the domain of rice; how exclusively one may judge when it is noted that forty-seven per cent of the total cultivated land in Shizuoka is in paddy. Tiny fields of tennis-court size, frequently irregular in outline and each surrounded by its diminutive dikes, give a characteristic "cubist" culture pattern to the alluvial lands. With the march of the seasons, however, there comes a series of transformations which adds variety to a landscape rather monotonously similar in its crop system.

To the eye, the delta-fans are essentially flat, but this impression is seen to be erroneous when one beholds the strong flow of water in the rivers, and in the irrigation canals as well, which form a network over the alluvial lands. The rivers on the lowlands are for most of the year, misfit, braided streams, flowing in extraordin-

arily broad, white, bowlder and gravel filled channels, flanked on either side by man-built dikes. The latter precaution becomes necessary both because of the flooding nature of these streams as well as their characteristic habit of flowing at, or even somewhat above, the general level of the bordering plains. Seen in the summer from a vantage point on the mountain slopes or terrace lands, the broad, rock-strewn stream courses are like white or gray ribbons in a background of green. Their lack of depth and their braided nature cause them to be of little use for navigation, but at the same time the elevated nature of their channels makes a gravity irrigation system a very simple matter.

In contrast to the low population densities of the mountains and terraces, the delta-fans give an impression of being full to overflowing with human life. Two cities of over 80,000 people, and a second pair with populations exceeding 35,000 are supported on the diminutive plains of Shizuoka, while smaller agglomerations of residences thickly stud their surfaces. All forms of communications reach their maximum development and concentration in these regions of small relief, each of the major delta-fans being traversed by the main Tokkaido Railway and Highway, with numerous feeder and branch lines of angular dendritic pattern radiating out from these trunk thoroughfares (Figs. 4 and 8).

The seaward margins of the alluvial lands are usually bordered by wide sandy outer beaches, frequently dotted by small fishing craft, the beaches culminating on their landward sides in one or more sandy ridges, which rise somewhat above the general level of the inundated alluvium, thereby becoming the sites for villages, highways, and railways. They are clearly differentiated from the alluvium by their lack of rice. The Enshu Coast, or that section from Cape Omae westward to Hamana Lake, which bears the full brunt of winds and waves from the open Pacific, is particularly smooth and harborless and in addition is fringed by a wide and formidable line of sand dunes, which latter handicap is not experienced by that section of the coast facing the quieter waters of Suruga Bay.

GEOGRAPHIC SUBDIVISIONS OF SHIZUOKA

Shizuoka, in this study, is areally differentiated into a triumvirate of major natural regions upon which has been superimposed an equal number of contrasting cultural landscapes. These major geographic units, possessing general similarity in site and culture,

are in turn, by reason of morphologic contrasts of a lesser magnitude, further differentiated into a larger number of subgeographic units[7] (Fig. 5).

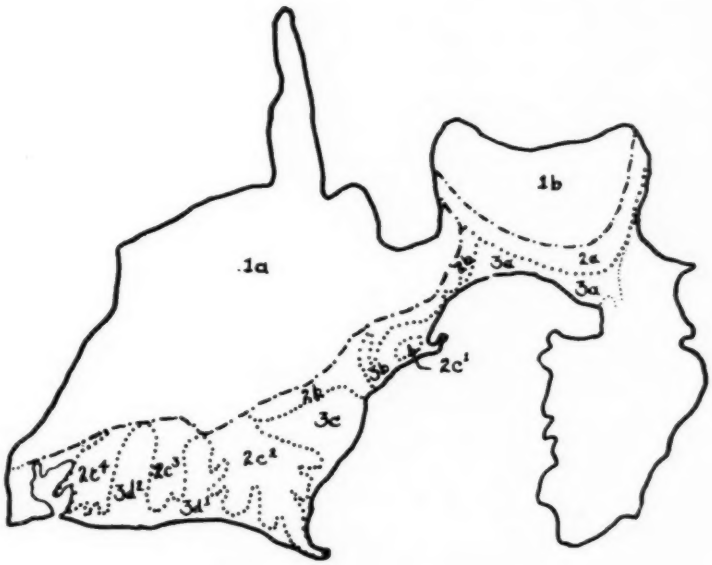

FIG. 5—Geographic subdivisions of Shizuoka Prefecture.

1. The Forested Mountain Region.
   - 1 a. The Dissected Sedimentary-Rock Mountains.
   - 1 b. The Ash Cones of Fuji and Ashitaka Volcanoes.
2. The Foothills and Uplands of Unirrigated Agriculture.
   - 2 a. The Intensively Cultivated Lower Slopes of Fuji and Ashitaka.
   - 2 b. The Cultivated Foothills of the Sedimentary Rock Mountains.
   - 2 c. The Diluvial Terraces of Old Alluvium.
     - 2 c^1 Kuno Mountain.
     - 2 c^2 Makinohara.
     - 2 c^3 Bandenohara.
     - 2 c^4 Mikatagahara.
3. The Irrigated Delta-Fans of Recent Alluvium.
   - 3 a. The Fuji-Kiise Plain.
   - 3 b. The Abe-Tomoe Plain.
   - 3 c. The Oi Delta-Fan.
   - 3 c. The Oi Delta-Fan.
     - 3 d^1 The Ota Valley.
     - 3 d^2 The Tenryu Plain.

[7]The complete outline of the author's plan for areal subdivision of Shizuoka is found under "Contents" on page 127. See also Fig. 5.

1. The Forested Mountain Region

This largest of the geographic units, representing one-half to two-thirds of the area of the prefecture, has unity largely through its poverty in cultural forms and the prevalence of steep slopes (Fig. 6). Here, much less than on the uplands or the plains, man has failed to imprint the marks of his tenure. The paucity in natural resources which the mountains have to offer are the reason for human avoidance of the district except in restricted areas and consequently the sum total of man's works is small indeed.

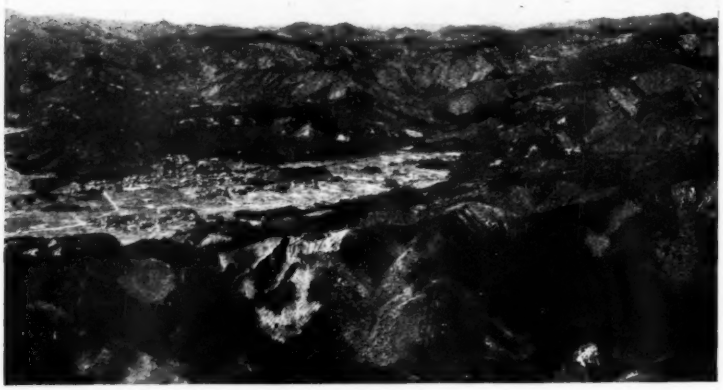

FIG. 6—A portion of the dissected sedimentary rock mountains. Note the patchy forest-cover.

Although inherently inhospitable in itself, the mountainous hinterland is benign in its influence upon the populated lowlands. From its heavily watered, vegetation-covered slopes flow the permanent streams which make possible the intensive, irrigated agriculture of the delta-plains, while the industrial developments in these same areas are no less dependent upon the hydroelectric power generated at numerous sites along the steep gradient mountain rivers (Fig. 7). No other single factor perhaps has been so effective in stimulating the expansion of manufacturing industries in Shizuoka during the past two decades as the development of

this new, abundant, and relatively inexpensive local source of power. The average annual precipitation recorded at the two meteorological stations of Hamamatsu and Numadzu, is seventy-nine and eighty inches[8] respectively, but it is safe to assume that it is more in the mountains, so that in spite of the small drainage

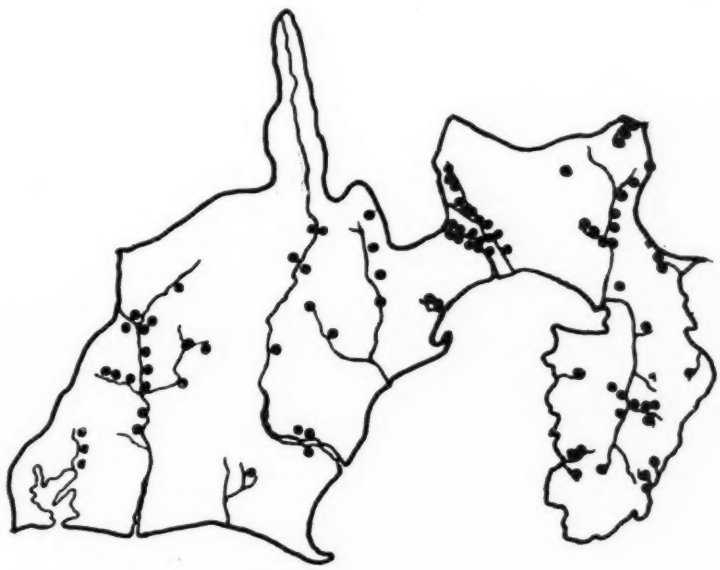

FIG. 7—Map showing the location of hydroelectric power stations in Shizuoka Prefecture. From *The Geography of Shizuoka Prefecture,* published by the Shizuoka Department of Education.

basins of the Shizuoka rivers they are able to provide sufficient volume and constant flow to make hydroelectric development profitable. Numerous small, inexpensive power developments are the rule however, the volume and general character of the streams not permitting the construction of plants of large magnitude. The following table indicates the quantity of hydroelectric power developed along the several rivers of Shizuoka prefecture.[9]

[8] *Meteorological Data for Japan* (In Japanese). Published by the Central Meteorological Bureau, Tokyo, 1924, p. 26.

[9] *The Geography of Shizuoka Prefecture* (In Japanese). Compiled and Published by Shizuoka Department of Education, p. 13.

1.	Kiise-Kano River Basin (Includes Izu Peninsula)	95,000	H. P.
2.	Fuji-Numa River Basin	23,000	"
3.	Abe "	27,000	"
4.	Oi "	276,000	"
5.	Tenryu "	767,000	"
6.	Others Rivers	25,000	"
	Total	1,213,000	"

As a climatic barrier the mountain wall to the northwest is a tremendous advantage to the coastal lowlands of Shizuoka where the inhabitants bask in a brighter, warmer, winter climate, an earlier spring and later fall, than do stations on the opposite side of Honshiu. The mountain mass forms a very distinct and effective climatic divide between the northwest and southeast coasts, so that while the littoral along the Sea of Japan is enduring a most depressing winter with gray skies, raw cold, deep snow and nerve racking winds, as determined by the onshore Asiatic monsoon, Shizuoka on the leeward side of the climatic divide has a brighter, more pleasant winter with high day temperatures and only occasional snow flurries. The climatic contrast between the two coasts is clearly indicated by the following table which compares Kanazawa and Numadzu, the latter a station in the Kiise delta-fan in Shizuoka and the former in a west-northwest direction from Numadzu on the Japan Sea littoral.

Climatic Data for Numadzu and Kanazawa[10]

(Temperature in Degrees Fahrenheit; Precipitation in Inches)

	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Year
Mean Temperature													
1. Numadzu	41.5	42.8	48.0	56.8	63.1	70.0	76.5	78.6	73.2	63.3	54.3	45.9	59.5
2. Kanazawa	36.5	36.3	41.7	52.0	59.9	68.0	75.4	77.9	70.7	59.7	50.2	41.2	55.8
Hours of Sunshine													
1. Numadzu	189.2	179.3	193.1	191.7	207.9	168.6	197.5	230.9	171.2	165.2	177.5	196.3	2268.4
2. Kanazawa	58.7	80.8	128.1	175.0	204.9	165.1	187.4	220.1	154.2	152.1	112.4	65.5	1704.2
Precipitation													
1. Numadzu	3.27	3.33	5.96	7.73	7.28	9.06	8.91	9.18	11.15	7.25	4.33	3.22	80.23
2. Kanazawa	10.91	7.39	6.61	6.43	5.69	7.23	8.26	6.48	9.42	8.04	10.58	13.88	101.02
Number of Rainy Days													
1. Numadzu	7.9	7.9	12.3	13.9	13.0	15.2	13.9	11.6	15.7	13.2	9.9	7.8	142.2
2. Kanazawa	26.7	22.6	21.0	15.5	14.1	15.3	15.3	12.0	16.8	17.5	20.8	25.8	223.4
Days with Snow													
1. Numadzu	2.5	2.9	1.0								0.1	1.0	7.4
2. Kanazawa	17.9	16.7	9.5	0.8							1.0	10.9	56.8

a. The Dissected Sedimentary Rock Mountains

(Excluding the foothills which border the alluvial plains)

This geographic subregion is a typical segment of the mountain core of Honshiu. Vigorous stream erosion acting upon an ele-

[10] *Meteorological Data for Japan*, op. cit. (compiled).

vated rock mass of complex rock structure very adjacent to the sea, is sufficient to explain the sharp, angular, labyrinthine type of surface forms which characterizes most of the province. Maximum elevations of over 9,000 feet are reached on its extreme northern frontier, but heights of 4,000-5,000 feet, and relief of 2,500 feet are not unusual within fifty miles of the coast. Where the writer has had occasion to observe the rock materials of the mountains he found them to be largely shales and sandstones or combinations of these two (Fig. 6).

If data were available so that a detailed and accurate dot map of population distribution could be constructed for this geographic region, it would show a dendritic pattern, with long thin lines of dots or dot clusters following back along the major river valleys and their tributaries which form the natural routes of travel to and from the populated coastal plains, upon which the mountain folk are semidependent, both as markets for their indigenous products and sources of supply for at least a portion of their food and manufactured wares. A supplementary reason for man's choice of the river valleys is that in these locations are found the only patches of near-level land with an available water supply for irrigation purposes which may permit of a few square yards of precious paddy land being developed. The highway systems, coinciding as they do with the valley systems, are also in a measure dendritic in pattern. Built for slow moving and light traffic, and in a region where road construction is difficult, the highways are narrow, winding and rather unsatisfactory for motor travel. The abundance of road building material, however, in the form of hard rock from the mountain slopes and gravel from the river beds, has led to a system of hard, surfaced roads which is a genuine asset in a region of such abundant precipitation. A number of short, narrow gauge spur railroads feed into the main Tokkaido Line from the north but a majority of these terminate at the foothills (Fig. 4). Only two lines, one following the Abe Valley and the other the course of the Fuji penetrate into the mountain province. The rolling stock of these feeder lines is diminutive in dimensions and frequently antique (Fig. 8).

The mountain village is likely to be a long double line of houses, strung out along either side of the road which follows the course of the valley. Even in the mountains the Japanese are still village dwellers, their highly developed gregarious instincts preventing them from living in scattered and isolated locations. As

FIG. 8—Rolling-stock on one of the "feeder lines" of the main Tokkaido Railway.

the stream alternately swings across the narrow valley, impinging now against one mountain wall, now against the other, the road with its bordering dwellings, meanders like the stream, attempting as much as possible to remain on the inside of the meander curves where there is the maximum of level land. Numerous flimsy bridges, some of them requiring a toll pittance, make both slopes of the valley easily accessible.

The ensemble appearance of the mountain villages reflects the meager resources of the surrounding country which exacts hard labor in return for a poor living. Their whole aspect is one pointing to frugal living on the part of the inhabitants. Small, flimsy, inexpensive frame houses with roofs of bark or thatch and walls of straw and mud plaster adhering to a woven framework of split bamboo are the rule (Fig. 9). Glass windows are a luxury reserved for the well-to-do in these mountain communities, translucent paper being the common substitute. Large numbers of the houses are piled high in front with bundles of firewood, bark, and charcoal, reflecting the predominance of the tree crop in the economy of the villagers (Fig. 10).

Mineral wealth, which is frequently associated with mountains, tending somewhat to offset their otherwise meager resources, is

FIG. 9—Type of flimsy rural dwelling found in the mountains. Note the thatched roof and the windows of translucent paper.

FIG. 10—A mountain dwelling surrounded by products from the forests. The straw-covered bundles contain charcoal.

largely lacking in Shizuoka. In the Kune district on the upper reaches of the Tenryu, copper ore valued at 800,000 to 1,000,000 yen* is mined each year, this being however the single region of metallic-ore production. Building stone and ornamental stone in small amounts is quarried from the mountains and chiseled into the desired size and shape by the local stone cutters. In certain villages the tattoo of the stone cutter's hammer is a common sound.

The Cultivated Valley Floors and Adjacent Lower Slopes.—The serious lack of level land with available irrigation water for rice culture causes the mountain folk to depend more completely upon unirrigated grains, vegetables, and bush crops for their food resources as well as their cash incomes than is true in the delta-plains. Rice consequently bulks large in the import items from the lowlands. The narrow mountain valleys contain only the most meager of floodplains and where they do exist, as for instance on the inside of meander curves, the soil is likely to be coarse and stony and subject to floods. In such limited and precarious locations some rice is grown however. Not only the main valleys, but the tributary valleys or ravines as well, where spring-fed creeks may be capable of supplying sufficient water, are floored with terraced paddy fields, toward the heads of the ravines the fields becoming crescentic shaped strips two or three yards wide with retaining walls probably three to eight feet high. It should never be lost sight of in interpreting Japanese rural landscapes, that rice is not just an ordinary crop; its cultivation is almost a necessity among the inhabitants of Nippon. The universal consumption of rice as a food seems to make it imperative on the part of the farmer to cultivate a patch of that crop if it is humanly possible. He insists therefore upon growing it even in locations naturally unsuitable for an irrigated crop and made suitable only by an amazing expenditure of human effort. This is particularly true of rice culture in the mountain province.

Obviously, however, upland or dry-field agriculture must prevail. Summer sown vegetables (sweet potatoes, beans, daikon or giant radish, peas, carrots, etc.), millet, upland rice, and maize, together with fall sown barley and wheat are the usual food crops of the mountain dweller. These are planted both on the sandy and gravelly patches bordering the streams as well as on the lower slopes of the mountains most adjacent to the villages. On

*One yen is equivalent to approximately fifty cents in American money.

the latter sites the soils are thin and easily removed by slope wash so that some sort of crude terracing may be necessary. "Interculture," a kind of simultaneous rotation in which alternate rows of two different crops planted at different times, are grown together in the same field, is a prevalent practice on these upland farms where arable land is at a premium.[11] By this ". . close dovetailing rotation of crops in point of time, space and labor" three or four harvests may be obtained in one year. Such an intensive regime of cropping can be maintained only by frequent and abundant applications of manure, not to the soil however, but fed directly to the growing plants so that none of the precious fertilizer is lost.

Scattered along the sandy river margins, and occupying similar slope locations as the vegetables and grains, are small plots of mulberry and tea, the leaves of the former bush supplying the exclusive diet for silkworms. These perennial crops are normally intercultured with vegetables. Tea more than mulberry seems to be the specialized crop of the Shizuoka mountain folk. On the steep lower slopes tea finds satisfactory, if not its optimum environmental requirements, and provides a cash income in a region where food crops are not plentiful and must therefore be imported. Slope wash, which is a serious handicap in the cultivation of steep slopes in regions of heavy precipitation, does a minimum amount of damage when planted in tea, for the closely set bushes in hedges, with the long axes of the hedges at right angles to the slope, serve to anchor the soil and prevent active erosion. The tea plant is quite intolerant of poorly drained soils and slope location insures against this danger. At the same time, however, the lack of soil depth does not provide ideal conditions for the development of the bush's deep tap root system and shallow rooting in thin, droughty, stony soils would be a disastrous combination in any but a region of heavy precipitation well concentrated in the growing season.

The tea refirers and exporters in Shizuoka City are insistent in their belief that the finest quality leaves originate in these restricted mountain valleys. The so-called Kawane district along one of the tributary valleys of the Oi is particulraly famous for its superior teas. Tea men are inclined to attribute this quality

[11]See Ellen Churchill Semple—"Influence of Geographical Conditions Upon Japanese Agriculture," in *The Geographical Journal*, Vol. XL, Dec., 1912, pp. 589-603.

production of Kawane, and other mountain districts to a somewhat lesser extent, to some superior combination of environmental elements, but specifically what these elements are, and how they function, no one seems to know. The following quotation illustrates the type of statement that one is likely to find in the literature on tea. "The tea requires warmth as well as moisture. Hence the tracts for tea plantations are generally located at such places with a high altitude and along the rivers, streams, or lakes where a dense fog or a heavy dew is produced. Such regions are represented by Kawane district along the river Oi in Shizuoka and Uji district in Kyoto."[12] The author inclines toward the opinion that superior care, probably as much as superior environment, plays a rôle in producing quality leaves from the mountain districts. In these latter locations where arable land is at a premium, but human labor abundant, an amount of care can be lavished upon the growing plant as well as upon the primary processes of leaf curing which would be prohibitive in the larger plantations of the great commercial tea-growing areas.[13]

Cultural Landscape Lacks Animals.—The absence of herds of cattle, sheep, and goats grazing upon the mountain slopes is an important negative item of culture which strikes one as an anomaly in economical Japan. "This appropriate industry of high altitudes has developed in all other parts of the two hemispheres, from ancient Peru with its llama and vicuna herds at 12,000 feet in the Andes to the modern sheep ranches in the Rockies of Idaho."[14] Japan seems to be the exception and foreigners are quick to note it and to criticize. S. Paul Merton in two successive articles in the *Japan Advertiser* for May 22 and 23, 1923, takes Japan severely to task for her neglect to utilize the mountain pastures. Certainly a country which is waging such a terrific struggle to maintain the fertility of its soil would find in the animal manures a very useful adjunct to its present meager supplies.[15] Merton points out that while individual stock raising on a large scale may be impracticable over most of Japan, the situation admirably lends itself to a communal type of development, say a cow or two to a family.

[12]Taken from *The Cultivation of Tea*, an unpublished treatise prepared by The Central Tea Association of Shizuoka.

[13]Tea processing is dealt with in a later section.

[14]E. C. Semple, op. cit., *Geog. Jour.*, Vol. 40, p. 595.

[15]See also: "Food and Population," Editorial in *Japan Times*, May 27, 1923.

The reasons advanced by the Japanese in defense of their neglect of the animal industries are concerned both with environmental handicaps as well as flaws in the present economic system. Many of the unforested mountain slopes are too steep to serve as grazing lands, for cattle at least, while those that are not, are frequently covered with a native wild grass, harsh, coarse, and unnutritious, which stubbornly resists all attempts at eradication. Miss Semple cites two concrete cases of rather doubtful success, where the planting of tame grasses has been attempted.[16] The lack of natural pasture lands appears to be at present the most serious natural obstacle to the development of the animal industries. It is likewise true, however, that further expert investigation needs to be made concerning the nutritive value of native wild grasses and the possibility of their eradication and subsequent replacement by tame varieties, before an accurate verdict can be rendered relative to the magnitude of this handicap. The long, hot, humid summer climate which prevails in central and southern Japan is scarcely satisfactory for sheep, while the manufacture and preservation of dairy products is difficult for the same reason, with the additional handicap that natural ice is not available.

The mountain slopes cannot be obtained for grazing purposes free from rental charges for they are frequently in the possession of large capital interests which would probably permit of their utilization only at a price which would make animal raising unprofitable. Furthermore, the initial outlay in labor and capital in opening up waste lands and buying animals preparatory to becoming established in the livestock industry is a deterrent to most Japanese farmers, for as a group they are poor and without a capital surplus. The Japanese never having acquired a taste for milk or milk products as articles of diet, farmers feel no urge, either from their families or from commercial markets to engage in the dairy industry.

The Forested Slopes.—The identical handicaps of steep slopes, thin soils and vigorous slopewash which have discouraged agricultural utilization of the mountain province generally, have resulted indirectly and in a negative fashion in fostering the forest crop. About two-thirds of the entire area of Shizuoka is classed as forest or wild land and a very large percentage of this is

[16]Semple; op. cit., p. 595.

within the mountain province. Probably fifteen per cent of this is grown up in wild grasses and is essentially unproductive.

Area of Forests and Wild Lands in Shizuoka Prefecture, 1924:[17]

Coniferous	368,457	Acres
Broad leaf	261,533	"
Mixed	356,585	"
Bamboo	14,770	"
Total forest land	1,001,345	"
Wild land	179,608	"
Grand total	1,180,953	"
Area of Prefecture	1,625,500	"

Trees are the one crop which can profitably be grown over the province as a whole and forest products are therefore the most widespread and universal source of income among the mountain dwellers. The writer was informed that there are numerous villages in the mountains where the cash incomes of their entire populations are received through the sale of forest products in various forms, viz., logs, charcoal, firewood, mushrooms, bark, bamboo, etc. Traveling in the mountains one is very conscious of the importance of trees in the economy of the inhabitants as he witnesses the logging operations on hillsides, sees the village dwellings surrounded by piles of forest products, notes the log rafts on the larger rivers, or passes by on the roads wagons loaded with logs, firewood, and charcoal moving down toward the plains, or the returning wagons carrying their freight of rice, bran, flour, implements, etc. which the lowlands offer in exchange.

Protection Forests.—The forests of Shizuoka, like those of the rest of Japan, are subdivided into two groups according to use, namely, "protection forests" and "utilization forests." Such forests as are closely identified with the public welfare and whose unrestricted cutting would result indirectly in losses to the citizens at large are placed under special control of the government, bearing the name "protection forests" whereby their utilization is strictly prohibited or in some less urgent cases only regulated. The government may declare certain forests to fall within the

[17] *Annual Census for Shizuoka Prefecture,* 1925 (In Japanese), p. 73. These data are for the entire prefecture, including Izu Peninsula.

"protection" class when their preservation is critical in connection with the following items of community well-being:[18]

1. The prevention of soil denudation in the mountains with its corollary of flood control.
2. The conservation of the sources of water supply.
3. The prevention of devastation due to flood, wind, and tide.
4. The prevention of avalanches and rolling stones.
5. The prevention of shifting sands and dune migration.
6. The preservation of forests associated with fishing grounds.
7. Preservation of forests serving as landmarks for navigation.
8. Preservation of forests in the interest of public health and sanitation.
9. The preservation of forests associated with the scenic beauty of temples, shrines, and historic sites.

Protection forests may not be utilized without official permission and the government retains the right to determine what protective measures shall be applied and to prepare the working plans relating to afforestation, the felling of trees, etc. When privately owned forests are placed in the "protection" list the loss sustained by the owner due to the prohibition of tree cutting is compensated for by the government or by those who benefit directly by the protective measures.

In Shizuoka the area designated as "protection forest" is relatively small, amounting in all to only a little more than 28,500 acres or about 2.3 per cent of the wooded area, ninety per cent of which has been so designated for the purpose of preventing soil denudation with the consequent flood menace to the plains below.[19]

Ownership and Utilization.—On the basis of ownership the forests of Shizuoka, like those of Japan in general, are classified into Imperial, State (public), and private forests. The Imperial forests, which include approximately one-fifth of all the woodland of the prefecture, are in the possession of the Imperial Household and under its direct control. The state or public forests are estates of the nation and are under the management of the gov-

[18] *The System of the Protection Forest as Seen from the Technical Point of View* (In English). Published by the Department of Forestry, Ministry of Agriculture and Forestry, Tokyo, 1926.

[19] *Annual Census for Shizuoka Prefecture* (In Japanese), 1925, op. cit., Table 80, p. 78.

ernment. The management of the private forests is practiced by their owners although under the guidance and encouragement of the government as well.

The sylvicultural treatment and economy of forests differ according to their ownership. Those belonging to the Imperial Family or to the State are generally renewed as a result of natural growth and they are therefore likely to be less uniform in composition and appearance than are the more carefully tended forests owned by individuals where the chief object is quick and frequent returns. This latter consideration is not so imperative in the case of Imperial and state forests and consequently a high-forest, timber-tree treatment is more frequently followed, the rotation period, depending upon the species, varying from fifty to two hundred years.[20] The economy of private forests does not so often permit of a high-forest system and more frequently a short or medium system of rotation is utilized. Representative of the latter rotation is the "coppice-with-standard" system in which the underwood may be cut once in a decade or somewhat less frequently while the overwood is permitted to reach a more complete maturity. This treatment is especially adapted to small firewood areas, privately owned and worked, on which the paramount aim is the largest possible returns within the shortest period of time. Sometimes a two-storied, high-forest system is adopted in which, by planting light demanding trees of quicker growth, a double rotation system can be followed. Coppice woods are grown to supply firewood and charcoal, the demand for these products being unusually large in Japan where they are almost universally used as home fuel.

The planting of pure forest formations is not the usual sylvicultural method followed in Japan because of the greater risks involved from losses due to snow, wind, and the ravages of insects or disease. Present day planting aims to grow two or three different species in adjacent plots, or suitably mixed in the same plot. Because of the semi-intensive system of forest culture in Japan which involves the use of relatively small areas with various systems of rotation, as well as kinds of trees in all stages of growth, the mountain slopes with their numerous forest plots of multiple

[20] *Japan at the Beginning of the 20th Century* (In English). Department of Agriculture and Commerce, Tokyo, 1904, pp. 257-266 (p. 258). See also *Forestry of Japan* (In English). Department of Forestry, Ministry of Agriculture and Forestry, Tokyo, 1926.

hues assume a disordered but somewhat geometric landscape pattern which is quite unlike the appearance of our extensive forest areas in the United States. On the steep mountain slopes clear-cutting methods over large areas may be inadvisable because of destructive erosion, and therefore selective-cutting and shelterwood systems may have to be employed. Selective cutting is, however, inconvenient and where physical conditions permit, clear cutting is generally practiced.

The season for felling trees depends in a measure upon local conditions but in general the months from October to February inclusive are the period of greatest activity. At this time of the year agriculture is making little demand upon the time and energies of the mountain dwellers so that they are able to focus their attention upon work in the forest. The problem involved in transporting the forest products to markets on the plains is not an easy one in this dissected mountain region where economic conditions do not usually allow the construction of special forest roads. In Shizuoka, the rivers, although not navigable for power boats, serve as means of transport for log rafts (Fig. 11). The logs are usually stripped of their bark, holes are bored at either end and they are then bound together by grass rope into rafts, loaded

FIG. 11—Bundles of charcoal which have been brought down the Abe River on log rafts.

with bundles of firewood, bark, and charcoal and poled and guided downstream to the saw mills on the lower river, or to log depots adjacent to mill cities on the plains somewhat back from the river. Tenryu Station on the Tenryu, Shimada near the Oi, and Shizuoka, very adjacent to the Abe, are all important forest product depots or mill centers. River transport of forest products in Japan is under a handicap not experienced in most countries, for in Nippon so much water is diverted from rivers for irrigation purposes during the planting and growth of the rice crop that the lower courses of the streams are nearly dry. For this reason most of the river transport of forest produce is done between late fall and early spring. A further handicap in the utilization of the Shizuoka rivers is the erratic nature of their flow, for due to their short lengths, steep gradients and the small areas of their drainage basins they respond very quickly to rainfall variations, becoming dangerous torrents after heavy rains. Very considerable amounts of forest products go to market on one-horse wagons; this is especially true in regions which are not accessible to navigable streams (Fig. 12). The logs are infrequently large and heavy and the markets are always at lower elevations so that the haul is not a strenuous one.

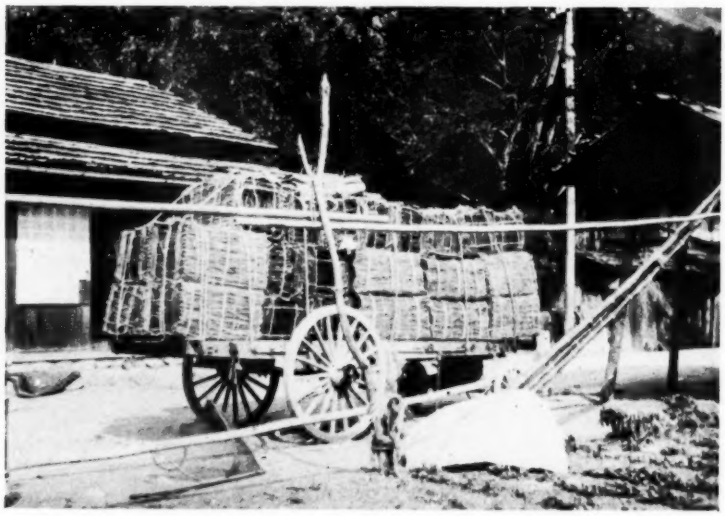

FIG. 12—Wagon loaded with charcoal enroute from a mountain village in the Abe Valley down to the delta-plain.

Forest Products.—One is forcibly struck by the relatively small amount of lumber cut from the Shizuoka forest lands. In 1924 the value of the lumber cut was considerably less than the value

Value of Forest Products in Shizuoka Prefecture, 1925:[21]

1. Lumber	3,337,724	Yen (1 yen, $.50)
2. Firewood	1,278,271	"
3. Bamboo	202,119	"
Total	4,818,114	"
4. Mushrooms	521,268	"
5. Charcoal	1,746,210	"
6. Others	355,407	"
Grand Total	7,440,999	"

of the charcoal and even in 1925 lumber made up less than fifty per cent of the total value of products from the forest lands. The small cut of merchantable lumber from Shizuoka forests is partly due to the prevailing sylvicultural methods that aim at short rotation systems which yield quicker returns than a mature, high-forest system can do. This practice is further encouraged by the large demand for small-sized, cheap lumber which is used in the construction of the flimsy frame and plaster houses which are almost universal throughout the country. Conifers, which are the principal timber trees, 30 to 40 feet in length and averaging eight to twelve inches in butt diameter, appear to be a common cutting size. The logs of suitable diameters are sawed into boards while those that are too small for such processing are left round or perhaps squared a little and in such form are used as joists and beams in the construction of dwellings. The following quotation emphasizes other reasons for the small yield of merchantable lumber. " The volume of the harvest as compared with the volume of the growing stock in the state forests is extremely small and indeed does not reach one half of what it should be. The reason for this abnormal yield must be sought in the fact that in most of the forests situated in hilly districts the presence of miscellaneous trees is seriously affecting the growth of timber trees, while in most of the forests the growing stock has not yet attained the normal 'age classes' . . . while the imperfect means of

[21] *Annual Census for Shizuoka Prefecture,* 1925 (In Japanese), op. cit., Table 69, p. 73. N. B. The figures in this table are for Shizuoka Prefecture, excluding the Izu Peninsula.

transport, absolutely considered, very much affect the extent of the utilization area."[22]

In preparing logs for market two by-products, firewood and bark, are obtained in commercial quantities. The former of these two products, although cut in greatest abundance from the forest undergrowth and the coppice woods, is likewise secured in large amounts from the smaller branches of the timber trees. In preparation for market, firewood sticks are cut into short lengths and tied into small bundles (Fig. 10). The importance of this item among the forest products is by no means minor for in 1925 the value of firewood was nearly two-fifths that of the lumber. Bark is also used for firewood, or when carefully removed in sheet form from the largers logs, is sold as roofing material.

Charcoal, next to lumber, is the ranking product from the forest lands of Shizuoka Prefecture. Its importance both relatively and absolutely strikes an Occidental as unusual but this is perfectly understandable when one considers the almost universal use of charcoal as a home fuel. The "hibachi," a jardiniere-shaped earthenware vessel, partially filled with fine powdery wood ashes, and with a few glowing embers of charcoal on top, is the almost universal means for heating in Japanese homes and in a large number of public buildings as well. The winters in central and southern Japan are, to be sure, neither long nor severe, but night temperatures below freezing are common and the air is damp and raw so that to an American, accustomed as he is to a central heating system, the hibachi-heated Japanese home is extremely uncomfortable. But the Japanese swath themselves in numerous layers of heavily padded garments and by sitting on their feet and huddling close about the hibachi are able to endure the cold.

Charcoal is usually made from deciduous wood, oak and chestnut being preferred. Coniferous wood produces a soft, quick burning charcoal, which, while it is suited to a few special needs, is not satisfactory as a household fuel where sustained burning is required. The so-called forests from which wood for charcoal manufacture is taken, are in reality not forests at all, but rather are coppice woods, which from a distance resemble cut-over brush land. The deciduous sticks for charcoal manufacture are cut into short lengths and burned by destructive distillation methods in

[22] *Japan at the Beginning of the 20th Century*, op. cit., p. 277.

kilns excavated in the mountain sides (Fig. 13). Charcoal is made in small amounts for home use at any or all times of the year as it is needed, but its manufacture on a commercial scale is quite largely a winter occupation.

FIG. 13—A small charcoal pit in the mountain province.

Of all the minor products of the forest lands, mushrooms are by far the most important. The 1925 crop was valued at over 500,000 yen or just a little less than one sixth the total value of the lumber. Shizuoka specializes in a variety of mushrooms known as "shiitake," which produces both in spring and autumn, supplying nearly eighteen per cent of the country's crop. The quantity production of shiitake mushrooms appears to be associated with certain kinds of trees which grow abundantly in Shizuoka and upon which this particular fungus prefers to grow.[23] In forests which are specially intended for mushroom production the coppice system of sylviculture is followed with a rotation of from eighteen to twenty-five years. In the state forests the litter, including leaves, twigs, pine needles, and cones, bits of bark, acorns, etc. is valuable as fertilizer or fuel in the estimation of the citizens who are permitted by the government to collect it at will. Shizuoka stands

[23] *Japan at the Beginning of the 20th Century*, op. cit., p. 263.

high among the prefectures in its growth of bamboo, but the cultivation of that tree is by no means confined to the mountain province. One can scarcely speak of a " forest of bamboo " since it ordinarily grows in relatively small clumps scattered here and there.

b. The Ash Cones of Fuji and Ashitaka Volcanoes

(Excluding the lower slopes)

In the extreme eastern part of " The Forested Mountain Region," or that section lying between the Fuji and Kiise valleys, the landscape changes from one of maturely dissected, sedimentary-rock mountains to one which is dominated by the superb volcanic cone of Fuji and its satellite, Ashitaka. Fuji's almost perfect cone rises by concave symmetrical curves to a height of 12,395 feet, towering high and imperious above the less elevated and more dissected cone of Ashitaka which lies on its southern and eastern flanks. The most beautiful thing about this superb mountain, Fujiyama, is its form, for ". . . it is the perfection of normality in young ash cones " and as a consequence is beautiful only from a distance where the full effect of its symmetry is apparent. The scars and furrows upon its flanks are minor blemishes, almost unnoticed, when the entire mountain is in focus. Only for a short three months in midsummer does Fuji entirely lose its snow mantle and it is at this time that hundreds make the arduous pilgrimage to its summit, there, atmospheric conditions being favorable, to behold such a panorama of varied Japanese landscapes as is scarcely to be had in any other part of Nippon. The quality of Fuji's beauty is never more real than on a clear day in fall when its snow-capped summit of raw, black scoria pierces and rises high above the cloud banners which encircle its medial slopes, while its lower slopes, more terrestrial in appearance, have the somber mottled hues of mixed forest and grasslands. It is little wonder that such a spectacle has been the source of inspiration for much in Japanese art and literature. Graceful and almost sublime from a distance, these qualities wane on close approach to the mountain. One traveler writes, ". . . I looked up from the darkish green of the fields at its foot along the dark brown surface of the mighty cone clear to the summit and its brute force, its iron weight shocked me."[24]

[24] Joseph I. C. Clarke, *Japan at First Hand,* New York, 1918, p. 216.

The inclination of the slopes of the two volcanic cones which compose the mountain province decreases with decreasing elevation until near their bases they flare out like the bell of a horn. Thus near the summit of Fuji the slope is approximately 35°, at the medial elevations it is only 20°, while at the base this is reduced to 5° or 10°. These latter slopes of moderate elevation are under intensive cultivation and because of the physical and cultural contrasts to the higher altitudes which they exhibit, are included within another geographic province. The upper limit of the zone of cultivation, which roughly coincides with the lower boundary of the mountain province, is not a line but rather an indefinite and irregular zone with numerous " inliers " and " outliers," whose elevation is approximately one thousand feet but going both above and below that elevation as relief and soil conditions vary. In general the zone of transition is at that elevation where increasing steepness of slope with the accompanying disadvantages of thinner soils and greater surface irregularities make agriculture unprofitable.

The landscape of the Fuji-Ashitaka mountain province is almost entirely natural and only in a very minor degree cultural. This condition is even more true here than it is in the sedimentary rock mountains farther west, for the volcanic cones contain no valleys where even meager settlement might become established. Man has not found a sufficiently hospitable environment, nor abundant resources to attract him to make conquest, consequently permanent settlements scarcely exist, roads are almost entirely lacking, while the summer pilgrims and those interested in the forest resources are virtually the only folk who frequent the region.

Th major variations in landscape are due to changes in the vegetation cover which in turn reflect the altitudinal zones. Above the cultivated foothills there extends a wide belt of mixed moorland and forest followed in turn at higher but indefinite elevations by zones of scrub, grass and finally bare lava and scoria. The cone of Ashitaka, rising as it does to elevations approximating only 4,500 feet, does not extend above the zone of moorland and timber.

Forest resources are the only exploitable source of wealth within this geographic sub-region and they are not large. The mountain slopes in previous decades have been stripped of their timber and adequate reforestation measures have not been applied, consequently stands of good timber are not continuous over large

areas, but rather they appear to be irregular and patchy with much intervening waste land (genya) which has grown up in coarse wild grasses. Much of the Fuji-Ashitaka forest land belongs to the Crown. This does not signify lack of utilization however, for annual cutting is the general practice. The forests are mixed coniferous and deciduous, with the former predominating except on Ashitaka, while numerous patches of bamboo dot the western flanks of Fuji.

2. The Foothills and Uplands of Unirrigated Agriculture

Of the three geographic units of first magnitude in Shizuoka this one presents the least unity in its natural landscape forms. Its essential similarities which make it a geographic entity and at the same time set it apart from the neighboring provinces are two-fold:

(1.) The position which it holds as regards completeness of utilization, intermediate between the thinly populated mountain province where the forest crop is dominant, on the one hand, and the intensively cultivated and densely populated irrigated delta-plains on the other;

(2.) Its specialization in commercial crops, particularly of the bush and tree varieties, and in grains and vegetables, which, like the perennials, do not require irrigation.

Within this major geographic province there are exhibited sufficient contrasts between, (1) the lower slopes of the ash cones of Fuji and Ashitaka, (2) the foothills of the sedimentary-rock mountains and (3) the several isolated, peninsular terrace remnants, to warrant their consideration as subgeographic units.

a. *The Intensively Cultivated Lower Slopes of Fuji and Ashitaka*

The geographic panorama of the ash cones is best seen perhaps from a vantage point on the elevated barrier beach near the coast. Mt. Fujiyama, which occupies almost the entire back country, descends by steep but almost geometrically perfect slopes and finally merges into an intensively cultivated, moderately sloping upland or foothill zone which encircles the mountain on the east, south, and west in a crescent-shaped belt. To the southeast the much lower and more rugged cone of Ashitaka mars the otherwise perfect symmetry of Fuji's lower slopes but the foothill uplands of the smaller mountain nevertheless join, and are con-

tinuous with, those of its larger neighbor, thereby completing the belt of upland to the southeast. Even at a distance of several miles this foothill zone, with the bright green colors of its growing crops and the checker board design of the small field plots into which it is subdivided, stands out in contrast to the more uniform and less lively color tones of the grass and tree covered mountains. An almost continuous single line of villages, like beads on a string, borders the highway which parallels the extreme outer margin of the Ashitaka foothill zone on the south, while numerous scattered villages dot the eastern and western flanks of Fuji. Dark green, timber flanked gorges gash the cultivated slopes, breaking at intervals the continuity of the line of villages at the base of Ashitaka, while tree capped irregularities, either isolated or as tongues from the mountain province, stand out against the background of cultured uplands. The junction of the volcanic uplands of Ashitaka with the alluvial plain on the south is relatively abrupt, in some places it is a low but almost perpendicular cliff, indicating perhaps wave erosion at some time prior to the deposition of the bordering alluvium (Figs, 14 and 15).

FIG. 14—The dissected volcanic cone of Ashitaka seen from the filled lagoon. Snow-capped Fuji is just visible above Ashitaka's western flanks. The moderately inclined cultivated lower slopes of Ashitaka terminate abruptly in a wave-cut cliff. Note the V-shaped valley on the extreme right.

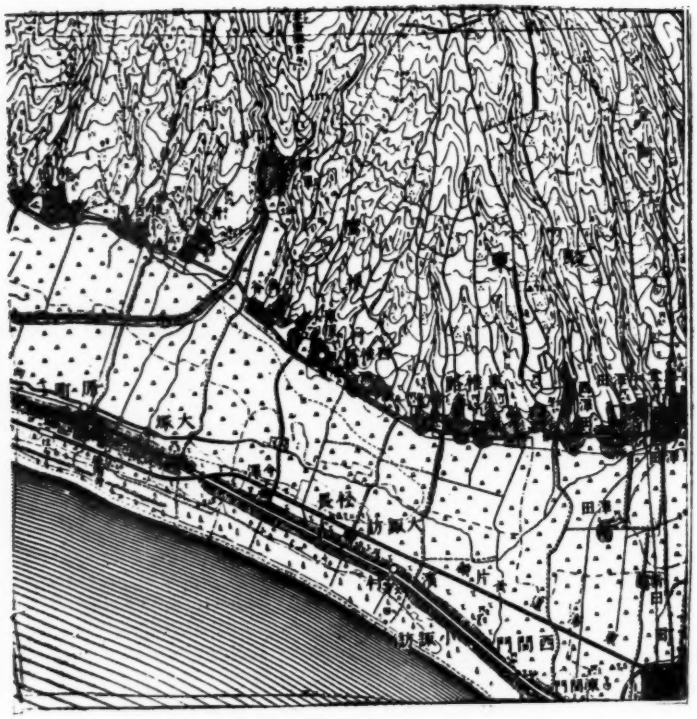

FIG. 15—A section of the topographic map (1/50000 Japanese Army Survey) showing the lower slopes of Ashitaka with the villages at its base, the filled lagoon planted exclusively in rice, and the unirrigated barrier beach followed by both the Tokkaido Railway and Highway. Contour interval 5, 10, and 20 meters.

1. Grass lands.
2. Orchards.
3. Tea.
4. Mulberry.
5. Irrigated rice.
6. Wasteland.
7. Bamboo.
8. Coniferous trees.
9. Deciduous trees.

The abundant waters from the higher elevations, where copious precipitation prevails, do not supply these lower slopelands with large surface streams for irrigation purposes, the underlying ash

and lava upon which the soils and subsoils rest being so porous as to preclude surface drainage except in a relatively few canyon-like valleys incised deeply into the upland surface. The moderately steep inclination of these ash uplands, together with the lack of large permanent streams, except along their extreme eastern and western flanks where the volcanic cones make contact with the sedimentary rock mountains, causes the cultivation of paddy rice to be almost entirely eliminated, resulting in a substitution of unirrigated grains, vegetables, and bush crops.

The intensive agricultural regime which characterizes this geographic province is supported and maintained by both natural and artificial resources. A layer of mantle rock several meters deep, composed of weathered lava and subaerially deposited volcanic ash covers the slopes. The upper soil is a black loamy clay or clayey loam, a trifle spongy in texture and rich in humus. The deep subsoil, lacking in humus, is brown or yellow in color thereby contrasting very markedly with the top soil. As upland soils go in Japan those of this province are reputed to be fairly fertile, but they are not capable of supporting a three-crop or four-crop annual rotation without heavy additions of both domestic and commercial fertilizers in the form of night soil, bean cake, fish guano and a number of others. So precious are manures in the agricultural economy of the Japanese that soil fertilization after the manner in which it is done in United States is not commonly practiced by the upland farmer in Nippon, but rather the individual plants or rows of plants, as in the case of grain, are fed from above by hand so that no fertilizer is lost to that soil with which the plant roots are not in intimate contact. Thus night soil in diluted liquid form is ladled to the growing crop by means of a long-handled wooden dipper, while the dry manures are sprinkled over the top of the soil immediately surrounding the plants. It is a case of "plant feeding" rather than "soil fertilizing."

The term "farm" is almost inappropriate as applied to the tiny irregular plots of cultivated land which give the characteristic geometric pattern to the upland landscape, for while they appear to be somewhat larger than the paddy fields they do not average perhaps more than one-eighth of an acre in size. The average area farmed by a family is likely to be about two and one-half acres although this is seldom in a contiguous plot but rather it is composed of a number of scattered areas. The farmer definitely plans to include within his scattered farm plots both paddy and

upland so that it will be possible to supply his family not only with the immutable rice diet but likewise with some variations in the form of vegetables and unirrigated grains, and perhaps grow a commercial crop as well. The cultivated plots are scarcely ever fallow for no sooner has one crop been harvested before another is planted to take its place; in fact by means of interculture methods two crops are frequently made to occupy the same field at the same time.

In late fall after the season for vegetables has passed, the same plots of ground take on a corrugated appearance as they are worked up into a series of narrow parallel ridges, twelve to eighteen inches wide, separated by ditches of about equal width and depth. On these ridges are sown thick, closely planted double or single rows of barley, rye, or wheat. The custom of planting the winter-sown grains in rows on ridges may be a habit borrowed from the methods of winter-grain culture on the lowlands where poor drainage makes ridging the fields a necessity. This requirement is not imperative on the well drained slopes of Fuji and Ashitaka however, but planting in rows rather than broadcast sowing recommends itself to the Japanese farmer for other reasons. It leads, in the first place, to a more simultaneous and equal sprouting, rooting, and development of the plants. It also permits of more careful and frequent cultivation, watering, and fertilization of the growing crop which in turn results in abundant returns per unit of area. During the mild winters which prevail in this part of Japan, and more particularly on these south slopes, the grain continues to grow up until the latter part of December, reaching a height of 6 to 8 inches by that time, resumes growth early in the spring and is therefore ready for harvest in late May or early June.

The summer system of crop rotation on these uplands, which include two and sometimes three crops, is more diversified, the farmer being permitted to choose from a larger list of crops including such major ones as sweet potatoes, upland rice, daikon (giant radish), soy beans, buckwheat, maize, and a longer list of minor vegetables and grains. Sweet potatoes and upland rice hold premier positions in the summer landscape judged on the basis of acreage, with daikon, soy beans, maize, and buckwheat each with one-third to one-half the acreage of the first two. The important position of upland rice is not surprising when one considers

that one-half of all the food consumed in Japan is rice, either paddy or upland varieties, and predominantly the former (97+ per cent of the total rice crop by volume is paddy). To the natives, however, with their very sensitive and refined tastes concerning rice, the upland variety is quite inferior and as a consequence of its less desirability it is by no means so exclusive on the uplands as is paddy rice on the delta-plains. Daikon is a standard crop in upland fields, in this region frequently following sweet potatoes in the summer rotation. It is a long, white, tapering, icicle-shaped root and probably the most widely known and favored vegetable in Japan. Rich and poor alike consume it in large quantities and in numerous forms—raw, boiled, dried, and, above all, pickled. The Japanese diet, consisting as it does so largely of rice, is particularly flat and monotonous and daikon pickle is popular as a relish and appetizer. One of the common sights in rural Japan is the long strings of these white radishes hung up under the wide eaves of the houses to dry. The bean crop is frequently intercultured with the maturing winter grains. It is a popular vegetable, the high protein content serving to make it a satisfactory substitute for meat in the diet of a people who are meager flesh eaters. At the same time pulses recommend themselves to the agriculturist through the nitrogen-fixing properties of their root tubercles as well as the large amount of green manure which is furnished by the stems and leaves.

Two perennial commercial bush crops, tea and mulberry, are cultivated in abundance upon these uplands. The plots planted to tea are relatively small in area and widely scattered and with apparently some tendency to occupy frontier lands along the upper margins of the zone of cultivation, frequently existing in isolated patches in a moorland or woodland clearing on the irregular slopes with few or no other cultivated crops in the immediate vicinity. Teas from the Fuji and Ashitaka slopes are not renowned for their fine flavor although the color of their liquor is excellent.

Mulberry bushes, whose leaves are the almost exclusive food for silk worms, are a specialized crop particularly on the eastern and western flanks of the two volcanic cones. Because of its high degree of soil tolerance, mulberry is to be found in a wide variety of locations within the prefecture. Its specific locations, however, within the present area are determined apparently not so much by physical environment as by the advantage of adjacency to villages, whereby

the frequent pickings of bulky fresh green leaves do not have to be carried long distances to the worms.[25]

On both the extreme eastern and western margins of this province where the Fuji, Numa, and Kiise rivers pour their waters down the relatively steep troughs which are formed at the contact zones between the ash cones and the sedimentary rock mountains, the rural landscape is in some respects quite dissimilar to that of the province as a whole. In Japan wherever there is available water for irrigation, there paddy rice is sure to be grown, and these regions are no exception. The floors of both valleys are irregular and of steep gradient and the streams descend by cascades and rapids with numerous hydroelectric power stations and industrial plants along their courses. In spite of the difficulties involved in preparing such uneven surfaces for irrigated crops, the task has been accomplished and rice takes its place along with the usual vegetable, grain and bush crops of the uplands. Both valleys are served by rail transportation, the Kiise Valley being a link in the principal route of travel along the Pacific coast of Japan and therefore followed by the main double-tracked Tokkaido Line, while the western valley is served by a spur line which connects with the Tokkaido line at Fuji village. The very difficult and circuitous route of the Tokkaido Railway over the Fuji Range by way of the Kiise and Sakawa valleys will, within a few years, be eliminated when the tunnel is completed between Atami and Mishima. At present the Kiise Valley section of the Tokkaido Line has the steepest grade found along its entire route (2.5 per cent maximum), more than one locomotive per train being required on this particular section.

The line of continuous villages along the extreme outer margin of the Ashitaka upland reflects the desirability of this location. A series of springs issues forth along the base of the mountain where it makes contact with the alluvial plain and this abundance of clean water may have been a major factor in attracting settlement (Figs. 15 and 16). It was not the exclusive reason, however. The fact that the adjacent alluvial lowland is a recently filled lagoon, unusually wet and poorly drained, has forced the cultivators of the alluvium to live elsewhere than upon their " floating paddies " and so the higher and drier barrier beach along the sea margin of the filled

[25]For details concerning the rearing of silkworms and the silk-reeling industry see *Outlines of the Raw Silk Industry of Japan* and *One Thousand Facts About the Raw Silk Industry of Japan,* published by The Raw Silk Association of Japan.

FIG. 16—Spring in one of the villages at the base of Ashitaka.

lagoon and the lower slopes of the ash cones have been adopted as superior sites for concentrated residence. Of these two desirable locations, the latter has the advantage of being located midway between relatively large regions of paddy and upland cultivation and since most Japanese farmers till both kinds of land, the central location increases the accessibility of each.

Industrial Developments.—The foothills and delta-plains of the Fuji-Ashitaka region are one of the three major foci of concentrated manufacturing within the prefecture. The industrial plants belong exclusively neither to the uplands nor to the adjacent plains but spread over both geographic provinces and may therefore with almost equal logic be included within the discussion of either or both. The power resource, however, being a product of the foothills zone, the entire industrial development is here treated as a unit within the discussion of that geographic subregion.

Much of the recent small-scale type of industry in Japan has developed within the past two decades as a consequence of available, cheap hydroelectric power. Such is the case in Shizuoka Prefecture where a large part of the industrial structure depends upon this source of power. The sound of rushing waters and the

sight of full channels as one travels either the Kiise or Fuji valleys gives evidence of abundant available power, while the twenty to thirty small hydroelectric establishments which dot the landscape of these valleys as well as the spinning, filature, and paper mills of the uplands and the adjacent plains, testify to man's utilization of it (Fig. 17).

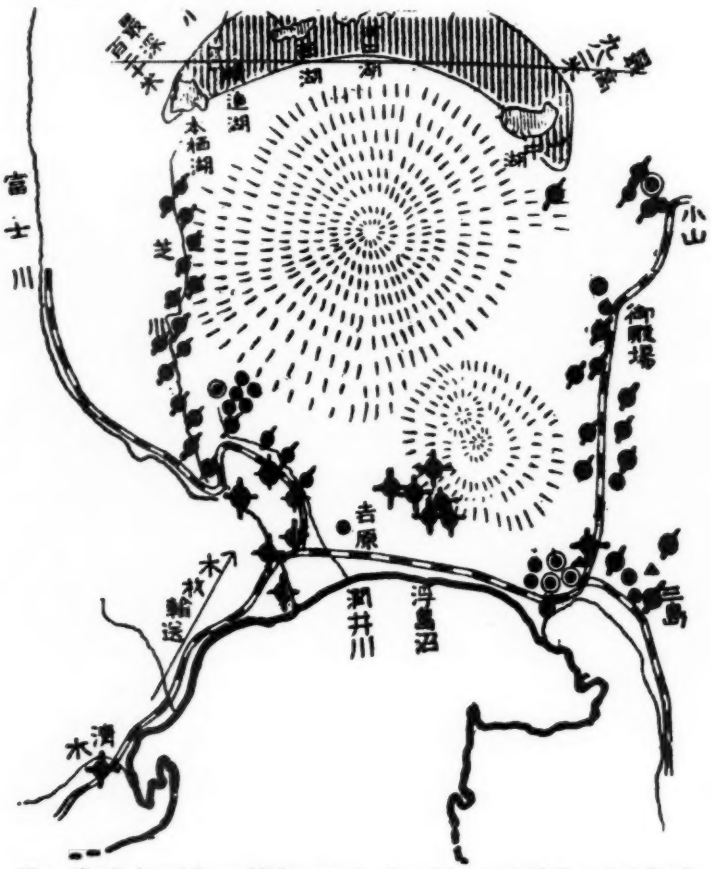

FIG. 17—Industrial establishments in the vicinity of Fuji and Ashitaka. From *The Geography of Shizuoka Prefecture,* published by the Shizuoka Department of Education.

1. Solid black dots are filatures.
2. Black dots within circles are spinning mills.
3. Dots with a cross are paper mills.
4. Dots with a single line through them are hydroelectric plants.

Paper Mills.—The census for 1925 gives Shizuoka third rank among the prefectures (after Hokkaido and Tokyo) in value of paper manufactures. In that year her mills produced foreign paper valued at nearly 17,500,000 yen, 83 per cent being processed in the plants located along the lower course of the Fuji River.[26] Five relatively large mills, areally concentrated, each employing in the neighborhood of 400-450 persons, and a half a dozen small plants compose the set-up of the industry in this region. The large mills are all of them specialized in the manufacture of printing paper. In the vicinity of each mill there are usually large piles of logs which have been brought by boat chiefly from Hokkaido and Sakhalin (Fig. 18).

FIG. 18—Piles of imported logs adjacent to a large paper mill in the Fuji Okitsu in Ambara Gun.

The present large scale paper industry of the Fuji Valley is a response to a combination of factors, including (1) historical antecedents in the form of earlier primitive plants for the manufacture of native paper, (2) cheap and abundant local hydroelectric power, (3) a plentiful supply of clean water easily obtained, and (4) close proximity to both rail and ocean transportation facilities. The modern paper mills represent an evolution from primitive

[26] *Annual Census for Shizuoka Prefecture,* 1925 (In Japanese), Table 110, p. 111.

plants for manufacturing native paper which formerly occupied the lower Fuji-Numa Valleys, attracted here by the available power from that river, the abundance of clean water, and the presence of raw material. The native papers were made from "mitsumata," a kind of shrub or wild bush which grew in abundance on the adjacent slopes of Fuji and Ashitaka. Some of the small plants in this vicinity still continue to make native papers although the advantage of an abundant supply of raw material within close proximity no longer exists, the mountain slopes having been depleted of their supply of mitsumata. But as the demand for foreign papers increased in Japan the small household industry of an earlier period has expanded into the present modern establishments, still finding elements of advantage in the old location.

Of even greater significance to the present paper mills than it was to their pigmy predecessors is the advantage of cheap power which the site provides. The abundantly fed streams which delivered power directly through waterwheels to the early mills are today performing the same services, but in the less direct form of electricity, which the industrial plants can buy at the rate of 1¼ cents per kilowatt hour.[27] Up until two years or so ago two of the mills were still using direct water power, but recently they too have adopted electricity. The handicap involved through seasonal fluctuations in flow is felt here but not to the extent that it is in many Japanese rivers.

An abundance of clean water is required in paper manufacture and this necessity is adequately supplied either directly from the streams or from the abundant sources contained in the sand and gravel subsoils of the delta-fan. These porous sediments are reservoirs for the surface and underground drainage from Fuji and Ashitaka and in some places the pressure is sufficient to produce flowing wells although ordinarily a 9 to 12 foot lift is required.[28] At Yoishiwara on the southwestern margin of Ashitaka, flowing wells are probably responsible for the cluster of small paper mills in that vicinity[29] (Fig. 17).

The earlier advantage of being located near sources of raw material from which paper was manufactured no longer exists for wood pulp from North America and logs from Hokkaido, Sakhalin,

[27]Conference with manager of one of the larger mills.
[28]Ibid.
[29]Ibid.

and Siberia are now taking the places of mitsumata and the poorer resinous woods from the neighboring mountains. As a consequence of the shift in the location of raw materials the Shizuoka mills are compelled to compete at a disadvantage with those of Hokkaido. This is partially offset, however, by the advantage of more abundant and relatively cheaper labor as well as the proximity of large markets for paper which the Shizuoka location possesses. Still further minimizing the disadvantage associated with the distant source of logs, are the combined water-rail transport facilities which this region possesses, for the bulky logs can be brought by ocean steamer to the port of Shimizu, only a few miles distant, and then by rail to the very doors of the mills. This proximity of an ocean port very materially reduces the transportation costs (Fig. 19).

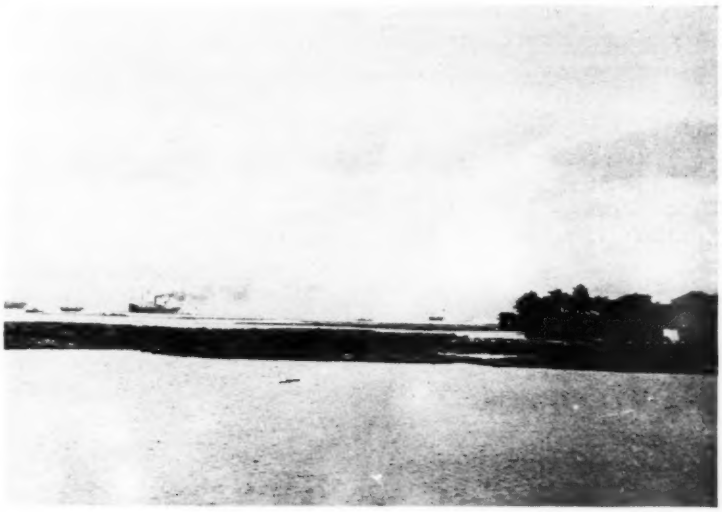

FIG. 19—Log rafts in Shimizu harbor. The logs are utilized both by the sawmills located along the margins of the bay and by the paper mills in the Fuji Valley.

Other Industries.—Other than power and paper manufacture the spinning of various kinds of yarns and threads is the only outstanding industry in eastern Shizuoka Prefecture. Cotton, wool, ramie, and silk all receive some attention but with major emphasis upon cotton, whose manufacture is concentrated in a single large factory at Oyama near the extreme northeastern boun-

dary of the province, and a small plant making thread and cloth at Numadzu, a city of nearly forty thousand inhabitants, on the Kiise Delta. The large and modern mills at Oyama are located on a river terrace overlooking the swift Sakawa River. The site is admirable from a number of standpoints, for hydroelectric power is easily and cheaply developed at very adjacent locations while the land upon which the factories and the employees' dormitories are located was largly wasteland and therefore inexpensive to purchase. Unconsolidated terrace sediments are very insecure foundations in an earthquake region, however, and upon the occasion of the Tokyo Earthquake in 1923 some of the mills at Oyama were badly shattered and a number of employees lost their lives.

In addition to the combination cotton spinning and weaving mill at Numadzu that city also supports a wool spinning establishment, three filatures and a plant which manufactures coarse thread from imported ramie or China grass. Factory managers and city officials alike were unanimous in their assertion that cheap hydroelectric power is of chief significance in attracting industries to Numadzu and vicinity. One other advantage is significant in the case of the ramie factory, according to its manager, namely, the abundance of clean water which is easily obtainable from the saturated delta gravels on which it stands. In the combined retting and bleaching processes applied to this imported fibre, an amount of water is used that is equal to three hundred times the weight of the fibre, which at this particular factory amounts to 144,000 gallons a day.[30] The manager was responsible for the statement that flowing wells could be obtained in this vicinity by merely driving pipes into the underlying gravels, while even the large volume of water required by this factory was being drawn from a sump not over four feet deep.

The filature or silk spinning industry is of a secondary magnitude both absolutely and relatively when compared with paper and yarn manufacture. The individual establishments are usually small affairs, for altho they number a dozen or more their combined output of reeled silk is only 2,000,000 yen. The cocoon supply for the filatures is largely local, this situation reflecting the relatively extensive areas of unirrigated upland in the vicinity, where mulberry is a significant crop. Like the other industries, filatures use electric power exclusively.

[30]Data obtained from manager of plant.

b. *The Cultivated Foothills of the Sedimentary Rock Mountains Between the Fuji and the Oi Rivers.*

Westward from the Fuji River to the valley of the Oi, and in a lesser degree somewhat beyond as well, site and culture in the foothills province are in some features unlike those of the ash and lava uplands just described. The long sweeping curves of Fuji's and Ashitaka's lower slopes with their deep volcanic soils are here replaced by irregular, precipitous, thin-soiled hills, the seaward margins of the sedimentary rock mountains. At the same time the imprint of man's occupation is dissimilar to that on the volcanic uplands for here his dwellings are almost completely absent, except in the valleys, and the specialized vegetable and grain culture is subdued, its position being usurped by a tea and orange-grove regime with woodland likewise abundant. Bush crops and tree crops seem to be particularly happy selections for this slope environment and patches of tea bushes and orange trees are found generally intermingled over the entire subprovince; in some parts even intercultured. In a few sections they may form the exclusive vegetation mantle but more commonly woodland dominates, with vegetable, grain and mulberry patches playing a minor rôle.

In many respects the physical environment of these foothills has little more to recommend it than has that of the genuine mountain back country. The hills are not as high to be sure but their slopes are quite as steep, their soils equally thin and just as hard to retain against despoilation by slope wash when under cultivation. Their one significant advantage, and the item which has been of paramount importance leading to their utilization, is the factor of geographic proximity to the populated delta-plains from which has come the abundant human energy necessary to subjugate these relatively barren hillsides and compel them to yield an increase. From the Oi westward, where there are numerous terrace uplands acting as buffers between the delta-fans and the mountains, the latter's foothills are less completely utilized and they have therefore not been included within this geographic subregion. The hill lands bordering Hamana Lake come the nearest to having a similar utilization to that of the eastern foothills, the cultivation of oranges being especially important.

It is difficult for an American to conceive of bringing under cultivation slopes of such a degree of inclination as has been done here in certain parts of this foothill zone. Many of them are so steep

that they would be considered unsuited even for pasture lands in this country and yet by dint of costly effort, urged on by stark necessity, they have been forced to yield crops of large commercial importance. Careful terracing is compulsory for orange culture, otherwise slope wash plays havoc with the already thin soil cover. The terraces or benches are cut back into the hillsides facing south, southeast and southwest, rising one above the other in the form of steps, and many of the steps are just wide enough to hold a single row of trees. The terrace fronts or retaining walls, to prevent slumping or washing, are faced with sod, or less frequently with smooth water-worn bowlders from the adjacent stream beds, the outer terrace walls sometimes being higher than the horizontal width of leveled land which they enclose. In places, the writer was told, soil is brought from the lowlands to cover the terrace surfaces.

Tea lands are either entirely unterraced or only leveled in a crude way for the closely planted hedges of this shrub tend to break the force of the falling rain and hence diminish the danger of wash. At the same time, the tea hedges, planted at right angles to the slope, tend through their root systems, to anchor the soil as well as to interrupt the sheet wash, thereby preventing it from accumulating any serious eroding power. This soil-protecting quality possessed by tea gardens has led to a frequent interculture of tea with the orange groves which tends to make terracing of an elaborate nature unnecessary. The relatively thin, stony soil cover of the foothills does not represent the optimum in physical conditions for the tea plant, nevertheless a prime prerequisite of adequate drainage is here assured and that plus the added fact that in competition with many crops, tea, because of its greater tolerance, is relegated to the marginal lands, like the region under consideration, has pointed the slopes toward this bush-crop specialization.

The Citrus Crop.[31]—The value of citrus fruit in Japan is about thirty per cent of the total annual fruit output of the country, and in 1925 Shizuoka, by a small margin, led all prefectures in the value of citrus products (4,792,182 yen), accounting for nearly twenty per cent of the total.[32] Within the prefecture this crop rep-

[31]The author is particularly indebted to Prof. Keizo Nagai of the Imperial Horticultural Experiment Station at Okitsu in Shizuoka Prefecture for the detailed information concerning the citrus industry.

[32]*Annual Report of the Department of Agriculture and Forestry,* 1925 (In Japanese), op. cit., p. 20-21.

FIG. 20—Dot map showing the distribution of citrus groves in Japan. (Courtesy of National Horticultural Experiment Station, Okitsu, Japan.)

resents fifty-four per cent of the value of all fruit and one single variety of citrus, the Unshiu mandarin, stands out so prominently (ninety per cent of all citrus) as to dwarf the only other varieties, the navel orange and the Japanese summer orange, which are here produced in only very minor quantities (Fig. 20).

The predominance of mandarin oranges in this most northern section of Japan's citrus belt, according to the Japanese experts, reflects the ability of that hardy variety to thrive in higher latitudes with somewhat more severe climates than its close relatives are able to do. According to Coit,[33] the Unshiu or Satsuma mandarin of Japan will endure more cold than any other variety of edible citrus fruit except perhaps some of the hybrids. From the available climatic data, however, it is difficult to note any appreciable contrast in temperatures between the Shizuoka citrus district and those farther south at Wakayama and Oiita.

Climatic Data for a Number of Citrus Growing Areas.

Tokyo is included for the sake of comparison. The starred stations are in Shizuoka Prefecture.

Station	*Length of Record*	*Altitude*	*Average Temp. of Warmest and Coldest Month.*	
	Years	Meters	*January*	*August*
1. Tokyo	38	5.8	37.4	77.9
*2. Numadzu	38	7.3	41.5	78.6
*3. Hamamatsu	38	27.7	41.0	78.6
*4. Okitsu	..	....	42.4	79.5
5. Wakayama	38	14.6	40.8	80.4
6. Oiita	37	5.9	41.9	78.8

Mean of Daily Minimum Temp. January	*Days with Frost*	*Hours of Sunshine per year.*
29.5	77.3	2124
32.5	44.5	2268
34.2	17.2	2219
34.0	41.6	2002
33.8	33.6	1961

It should be pointed out though that the records for the several stations listed in the above table are not simultaneous, nor are they for the same number of years, and hence the data are not entirely comparable. In his unpublished paper on citrus, presented before The Pan Pacific Science Congress, 1926, Mr. Nagai ap-

[33] J. Eliot Coit, *Citrus Fruits*, New York, 1920, p. 79.

pends a note to the temperature table appearing there, stating that although the climatic data do not show it, he feels that the actual temperatures in Shizuoka are slightly lower than those prevalent in the more southern orange districts. The writer is unable to harmonize the conflicting testimony and is compelled to set down the previously stated interpretation of mandarin specialization without verification from the climatic data.

The Unshiu mandarin grows on a small, dwarfish, round-topped tree which bears its fruit in a prolific fashion in late November and early December. The early pickings are therefore able to reach the Canadian market before the Christmas season. The fruit is decidely oblate in shape, of medium size (two to three inches in diameter), having a very soft flesh and with a deep orange-colored skin which can be easily peeled. Acidity and sweetness are well blended in them so that their flavor is delicious. Compared with the oranges from farther south in Japan, the Shizuoka fruit is reputed to be deficient in flavor, being more acid and less juicy, and this may be due to the less ideal temperature conditions in which it grows. At the same time, however, this disadvantage is partially offset by the superior keeping qualities of the northern as compared with the southern product which makes the former a superior storage and export fruit. The abundant crop of mandarins causes the market to be flooded immediately after harvest, the price drops, and consequently the fruit which can be preserved in storage through the winter and spring, commands prices double and triple those of the harvest season.

Navel oranges are relatively poor in quality in Shizuoka, which lies in the northern part of the citrus region of Japan, and are not comparable to those of the supposedly warmer latitudes of Kiushiu and Shikoku. At the same time the thin-soiled slopes of the Shizuoka citrus locations are much less satisfactory for the more exacting navel stock. The Japanese summer orange, like the navel, thrives better in the more southerly locations and although considerably more important in Shizuoka than the navel, it is of relatively minor significance when the whole citrus crop is considered.

Shizuoka's prominent position as a citrus center is in a measure associated with the favorable climatic environment which the seaward margins of that prefecture possess, but that this is the exclusive interpretation is open to question. The historical antecedents of many forms and varieties of regional specialization in

Japan are either unknown, or if they are known, they are often scarcely available to a foreigner who is laboring under the handicap of conversing through an interpreter or directly by means of very broken English. The writer does not feel competent, therefore, to estimate the quantitative value of the environmental factor since the historical factor is an unknown.

Shizuoka Prefecture does have a plus temperature anomaly during the cool part of the year as compared with other Pacific Coast regions of not very different latitudes, and it is perhaps true that this advantage is being consciously exploited through citrus specilization. This is the prevalent answer given by expert and farmer alike when faced with the question of Shizuoka's concentrated orange acreage. An analysis of the climatic data tends to substantiate the claim for mean monthly temperatures, mean of daily maximum temperatures, mean of daily minimum temperatures, the absolute maximum and minimum temperatures, are not greatly different in Shizuoka, which is almost the northern limit of oranges in Japan, from what they are in the citrus regions farther south along the Inland Sea and in parts of Shikoku and northern Kiushiu (See table on page 174). Somewhat more refined data might show greater contrasts but it is probably true that Shizuoka has winter temperatures nearly, if not quite as mild, and summers approximately as hot as some of the citrus regions farther south. On the other hand the Tokyo area which is only fifty to seventy-five miles farther north, but on the opposite side of the Fuji Range, and outside of the citrus belt, has distinctly colder winters with more frost and less sunshine and rainfall than Shizuoka (See table). It would appear, therefore, that the Shizuoka orange belt lies at about the northern limit of citrus in Japan but in a local area of relatively high temperatures, heavy precipitation and large amounts of sunshine (See table, p. 174). It may be true also that the large metropolitan markets of Tokyo and Yokohama to the north have been a factor attracting citrus culture just as far north as climatic conditions will permit. The plus temperature anomaly of Shizuoka may be partly attributed to the great width and height of the mountain wall which here interposes itself as a climatic divide preventing strong temperature importations from the north and west.

Regional Distribution of Citrus Orchards within the Prefecture.—Citrus culture in Shizuoka prefecture is concentrated along the southward facing slopes of the foothills between the Fuji and

the Oi Rivers, facing the quieter and more protected waters of Suruga Bay, and those bordering Hamana Lake. The pattern of the dots showing distribution of the orchards would be somewhat scalloped, the indentations resulting from the tendency of the orchards to follow back along the slopes of the river valleys where the hills remain adjacent to densely populated and carefully utilized alluvial lands. Most of the citrus land is held by farmers who are also cultivators of paddy rice, and live on the plains, for adjacency to the irrigated lowlands is a prime factor to be considered in the utilization of any slope.

The concentration of citrus orchards on the steeply inclined foothills of the sedimentary rock mountains is related, both in a positive and negative way, to the environmental complex. Crop competition plays a major rôle in largely eliminating oranges from the level alluvial lands, the more moderately sloping volcanic uplands, and the flat topped terraces, where conditions of slope make them more desirable for crops of annuals, requiring as they do abundant and frequent attention. It is true that the steep flanks of the terrace lands, particularly those with southerly exposures, are frequently planted in orange groves, but here slope conditions closely approximate those found along the foothills of the sedimentary rock mountains.

Because of soil and air drainage, the hill slopes are both warmer and drier than the adjacent lowlands. The delta plains other than that they are almost exclusively devoted to rice, are usually unfit for citrus owing to unsatisfactory drainage. Figures are not available for a comparative study of frost conditions on the orchard-planted slopes and the alluvial plains, but it is significant that Hamamatsu at an elevation of 27.7 meters on a terrace has only 17.2 days of frost on the average during the year, while Numadzu in the Kiise Delta, 7.3 meters above sea level, has 44.5 frost days.[34] Temperatures below 20° or 22° are scarcely ever experienced even on the plains of Shizuoka and it is fair to assume that the minima on the hill slopes are a few degrees higher. Cases of winter killing among the citrus orchards are quite unknown.

The southerly facing slopes are particularly superior because of their greater receipts of insolation which makes itself felt both in increased soil and air temperatures. This factor becomes more significant at the seasons of relatively low sun for on December

[34] *Meteorological Data for Japan* (In Japanese). Central Meteorological Station, Tokyo, p. 48.

22 the south slopes of 20° to 35° inclination are receiving 1.8 to 2.1 times as much solar energy respectively as are the horizontal surfaces of the adjacent plains. Where the hills closely parallel the coast as they do in Ambara Gun in the eastern part of the orange belt, reflected insolation from the sea surface is an added source of energy for the bordering slope lands.

Frost in itself, as has been previously stated, is very seldom, if ever, of such a severity as to do any damage to the hardy mandarin stock but occasionally during the winter strong cold winds from the north and west do serious injury to the young leaves or the trees may be even partially defoliated. As a consequence exposed and windy locations are avoided and wind breaks in the form of bamboo or matting fences or even shelter trees are resorted to. Normally orchards are not planted at elevations exceeding five hundred feet, both because such elevations are not found except at some distance back from the plains and for the additional reason that they are more subject to strong winds. Occasionally during late summer and early fall tropical hurricanes move from south to north across Japan generating violent winds which are destructive to crops and buildings alike. From such storms the lands bordering the protected waters of Suruga Bay receive far less injury than those west of Cape Omae which feel the gales from off the open Pacific. The ideal locations are the southward-facing, amphitheater-shaped depressions along the hill slopes, for these situations receive the maximum protection against winter winds as well as the maximum insolation. These superior locations are however already occupied and while there is much slope land still uncropped, the local site characteristics of these remaining lands are relatively inferior for orange groves.

Rainfall in the Shizuoka orange belt is more abundant than in any other citrus producing district in the world, totaling nearly eighty inches.[35] Nearly five times as much falls in September, the rainiest month, as in January which is the least rainy, but still having three inches of precipitation. The citrus area of the Inland Sea borderlands has only one-half as much rainfall as Shizuoka, and in some summers when rainfall is scarce the summer growth of the fruit is unsatisfactory. On the steep slopes where soils are thin and drainage extraordinarily efficient, frequent and abundant rains, such as characterize Shizuoka's climate, are beneficial.

[35]Nagai, op. cit.

Only a hardy variety of citrus such as the shallow-rooted Unshiu mandarin would thrive in the thin, stony soils which prevail in the citrus-bearing locations of Shizuoka. The slopes have in places been so denuded of their soil cover as to expose the underlying shale and sandstone beds and everywhere the soils are coarse and stony, containing in some locations fifty per cent sand and gravel.[36] These do not represent the optimum conditions even for mandarins but in such an environment nevertheless that shallow-rooted tree attains a satisfactory growth, matures early, but at the same time the quality of the fruit is not of the best. Through the practice of terracing, greater depth of soil is frequently artificially provided at the immediate locations of the trees.

From Figure 20, which shows the distribution of citrus areas, it is very conspicuous that this industry reaches its highest degree of specialization in Ambara Gun in the extreme eastern part of the sedimentary-rock foothills. Orange culture terminates very abruptly at the Fuji River, the lower slopes of the volcanic cones beyond, where prevail deep soils high in humus and uplands of moderate inclination, having attracted a more intensive type of culture. The more complete utilization for orchards of the hills facing

FIG. 21—Orange groves and tea gardens on the mountain foothills near Okitsu, in Ambara Gun.

[36] Ibid.

the sea in Ambara Gun may reflect in a measure the almost entire lack of fruitful alluvial plain in that political subdivision from which villagers can earn a living. The semiprecipitous slopes rise abruptly, almost from the water's edge, so that the Tokkaido Railway has in places a roadbed carved from the solid rock of the mountain wall, in one section a long tunnel, and over long stretches cement sea walls have been constructed along the ocean side of the right-of-way to protect the tracks from storm waves. Along the Ambara hills insolation receipts, direct plus reflected, are probably at a maximum, creating a favorable temperature environment for citrus, while the inhabitants of the seaside villages, depending in a measure upon fishing and the tourist trade for a livelihood, have turned in a more noticeable degree to the resources

FIG. 22—A closer view of the terraced hill slopes near Okitsu, bearing mandarin groves. Note the retaining walls, constructed of smooth water-worn bowlders.

of the slopes to supplement their meager incomes, than have those villagers farther west in the deltas of the Abe and the Oi where there are larger areas of productive alluvium (Figs. 21 and 22).

Orchard Tillage.—The soil of the slopes which bear citrus groves is shallow and consequently the depth of tilling, which is prevalently done in winter after harvest, is less than seven or eight inches. Owing to the heavy rainfall and high summer temperatures, weeds grow abundantly and several weedings are necessary, especially in the case of young trees. In the older orchards where the ground is better shaded the weed nuisance is not so great. It is the practice in Shizuoka to scatter the pulled weeds over the ground under the trees in order to prevent soil wash, check evaporation from the soil, and also to prevent the further growth of weeds. After the weeds decay they are mixed with the soil, thereby adding to its organic content. The same climatic environment which fosters the growth of weeds likewise favors the propagation of injurious fungi and insects, and serious damage to the trees and fruit results if growers are not constantly vigilant in checking their ravages. The most successful growers spray five or six times a year, the solution used varying with the particular insect or fungus being attacked.

Trees with well balanced oblate tops, exposing as they do more surface to the sunshine, are the most valuable, and careful growers prune with that object in mind. Unshiu trees bear only a few and tiny fruit on their inner branches which receive little sunshine, consequently the inner branches are eliminated by pruning, thus shifting the nutriment to other branches. Even though this procedure may result in fewer oranges, the larger and more valuable fruit which the outside branches bear, more than compensates for the loss in numbers.

The Unshiu trees grow more vigorously in proportion to the amount of fertilizer given than other citrus varieties do. The quantity of fertilizer given to navel oranges is twenty to forty per cent more than that given to Unshiu. In fact, for the latter, an excessive amount of manure actually reduces the quality of the fruit, causing the flavor to become flat and the rind too loose. Large applications of bean cake, which is high in nitrogen, seem to be particularly injurious. Merely to reemphasize therefore the previously stated relationship, that this hardy citrus in which Shizuoka has become specialized seems to be a very satisfactory choice as a crop on the sedimentary-rock slopes where coarse and

relatively infertile soils prevail. Various kinds of fertilizer are used by the orchard men; bean cake, fish refuse, stable manure, night soil and ammonium sulphate to supply the nitrogen; steamed bones most frequently provide the necessary phosphoric acid, while wood ashes and potassium sulphate replenish the potash content. Lime is usually added at about the rate of 350 to 700 pounds per acre. Conservative as the Unshiu is in its demand for fertilizer, nevertheless the expenditures on this item are high, totaling perhaps $80 to $100 per acre.

Marketing.—Picking of Unshiu oranges begins early in November but the fruit is best suited for removal from the trees in December. If they can afford to, the growers prefer to store their fruit in warehouses until several months after harvest rather than to throw them upon the already flooded market in December when prices are low. At the same time the quality of the fruit improves during storage but there is usually a loss of about 20 per cent through decay.

The foreign export of Shizuoka oranges, almost entirely to western North America, is small compared with the quantity of the crop which is consumed at home, probably not more than ten per cent, yet in 1926 this amounted to some 500,000 boxes valued at $250,000.[37]. This export is handled entirely through the adjacent port of Shimizu, where transpacific steamships call only during the tea and orange seasons. The entire foreign export moves from Shimizu in late November and early December for it is highly important that they reach their North American destination in either United States or Canada during the Christmas season.

Destination of Exported Oranges (in tons) from Shimizu. November-December, 1925.[38]

	Vancouver	Victoria	Seattle	Tacoma	Total
November	3799	348	642	73	4862
December	63	10	154	22	249
Total	3862	358	796	95	5111

The earning power of Unshiu orchards varies considerably depending upon the nature of the growing districts and the care given by the growers. Mature and well managed orchards pro-

[37]Data from Imperial Horticultural Experiment Station and subsequently verified at Shimizu Customs Office.

[38]Data obtained from exporting agent at Shimizu.

duce, on an average, 1200 to 1500 kwan per tan and the prices of the fruit vary according to years and seasons, the average price being 30 sen a kwan.[39] Accordingly the gross earnings of a good orchard is 360-450 yen per tan, which translated into American monetary units would be 700-750 dollars per acre.[40] The net returns, however are probably only one half this amount.

The feeling seems to be prevalent among horticulturists that the citrus industry in Shizuoka is not due to expand and may on the contrary decline, at least in relative importance. Warm as Shizuoka may be considering its latitude, it is not as desirable in site characteristics for orange groves as are certain sections in far southern Japan, and it is in the latter locations that the real expansion in citrus area is at present taking place. The preferred local orchard sites in Shizuoka are already occupied which acts as a deterrent toward further expansion. "Very little empty space is left for the culture of citrus fruit in the prefectures of Wakayama, Shizuoka, Osaka, and Kanagawa, but a considerable area is available in the prefectures in Kyushu and Shikoku, where the climate is warmer than in the aforesaid districts; and accordingly it is likely that the citrus fruit industry will make a conspicuous growth in this district in the future."[41]

c. *The Diluvial Terraces of Old Alluvium*

The prongs and isolated islands of terrace which rise by abrupt and sometimes precipitous slopes to conspicuous heights above the alluvial plains, are remaining interstream fragments of much more extensive deposits, which since uplift have been removed by stream erosion, so that the present remnants are discontinuous. The latter owe their continued preservation in a large measure to stream-divide locations but in the cases of Kuno Mountain and Makinohara, the diluvial gravels rest upon foundations of sedimentary rock and these resistant pedestals may have been an additional factor in their defense against annihilation by river erosion.

c[1] *Kuno Mountain*

Kuno Mountain has roughly the appearance of a flattened dome, slightly over 300 meters high, the south half of which has either

[39] 1 kwan = 8.267 pounds. 1 tan = .25 acres. 1 sen = ½ cent.

[40] Nagai, op. cit.

[41] Nagai, op. cit.

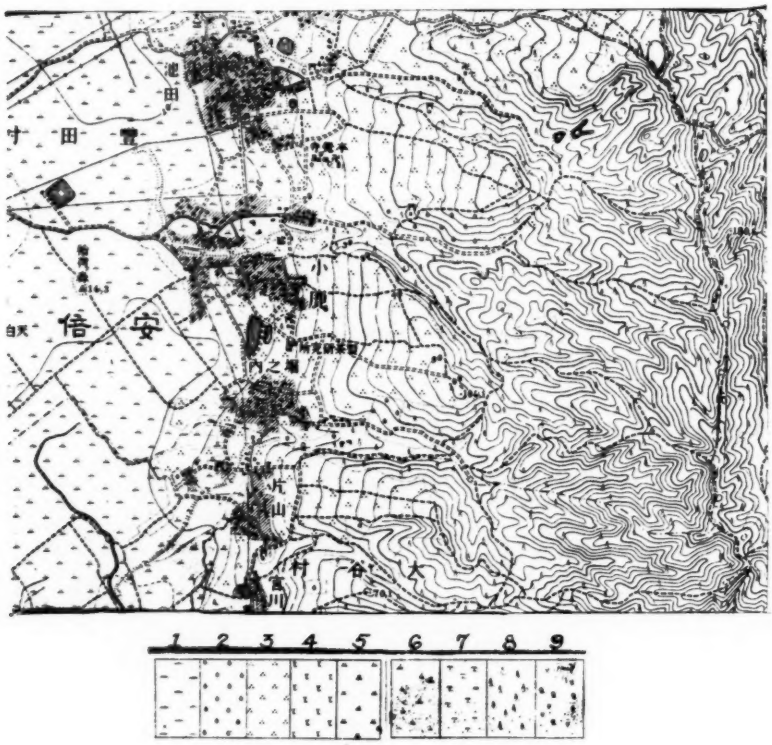

FIG. 23—A section of the topographic map (1/25000 Japanese Army Survey), showing the western flanks of Kuno Mountain, and the adjacent Abe Plain. Villages occupy an intermediate location between the alluvial plain and the diluvial terrace land. Eastward from the villages are the smooth surface "facets" of Kuno devoted to tea and various crops of annuals. Back of the "facets" rise the higher and more rugged slopes where forests predominate. Contour interval 10 meters.

1. Grasslands.
2. Orchards.
3. Tea.
4. Mulberry.
5. Irrigated rice.
6. Wasteland.
7. Bamboo.
8. Coniferous trees.
9. Deciduous trees.

been cut away by sea waves or down-faulted, leaving a precipitous slope on the ocean side.[42] A portion of what appears to be the original uplifted depositional surface of the terrace, perhaps 200 acres in extent, and intensively cultivated, still persists at the very summit of the mountain, while similar smooth, inclined surfaces, one half mile to one and one half miles in depth, similarly utilized, fringe Kuno for approximately 100° to 140° on its western and northern circumference (Figs. 23 and 24). Between the sloping

FIG. 24—The western slopes of Kuno looking across the Abe Plain from a vantage point on a mountain outlier which is planted in tea gardens. Note one of the smooth-surfaced, intensively cultivated "facets" almost in the center of the photograph just above the high-tension tower. To the right is a second "facet." Above these cultivated lands rise the darker, irregular forested upper slopes of the mountain.

upland plain at the summit and those around the perimeter on the northwestern quadrant, is a maturely dissected region of sharp, angular land forms, with some cultivation, but for the most part left in timber or waste land. On the eastern flanks of Kuno, where

[42]So far as the writer was able to learn, no detailed study has been made of the physiographic history of Kuno. The suggestions relative to this topic which appear here are the result of casual, rather than careful, field observations, supplemented by suggestions from Japanese geographers. No attempt has been made however to formulate a complete and satisfactory explanation of all of Kuno's features.

waves and currents have attacked the mountain, the triangular shaped, moderately inclined surfaces of deposition are almost entirely lacking, and steep rugged slopes with scattered orange and tea patches meet the alluvial plains at a sharp angle.

The remnant of original terrace surface still persisting on the summit of Kuno is an intensively cultivated tea and vegetable garden. The relatively deep and porous soils seem to be particularly satisfactory for root crops as well as for the tea bush which has a long tap root and is quite intolerant of poor drainage. At the same time its elevated and exposed location with a slope toward the north brand it as a non-citrus location. This diminutive plain slopes northward toward the main mountain mass of Shizuoka with a fairly moderate gradient although portions are inclined at such an angle that slope wash and gullying would be injurious if it were not for the porous soil and subsoil which allows of little surface run off. In the areas of greatest slope the fields are frequently artificially leveled or roughly terraced. The soil is a brown or black loam, largely volcanic ash, and rich in humus. Some of the soil contains small water-worn gravels but over the area as a whole stones are not prominent. The subsoil, wherever the writer was

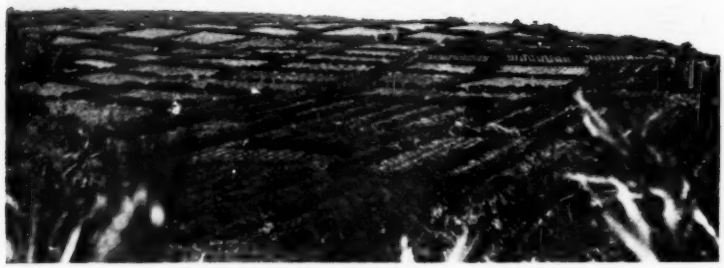

FIG. 25—The relatively smooth but sloping crown of Kuno with its rectangular pattern of tea and vegetable gardens. Note that the tea hedges frequently enclose the vegetable and grain patches.

able to see samples, was gravel and sand roughly assorted which is typical of the terrace deposits everywhere.

The summit surface is divided into small patches varying in dimensions but averaging perhaps five or ten to the acre. The Japanese topographic map indicates that it is exclusively a tea garden, which it not the case. Tea is the exclusive crop in many sections to be sure, and even in the others it holds a significant position, but it is compelled to yield considerable areas to the summer-vegetable and winter-grain combination. Daikon, the giant white radish, is especially prominent as a summer crop, with sweet potatoes a close rival, while in winter these same patches are seeded to winter grains. Tea and annuals are frequently grown on the same plot of ground, the bushes forming a hedge around the margins of the field with vegetables and grains inside of the hollow square thus formed (Fig. 25).

The farms on the summit surface of Kuno are owned and operated almost exclusively by the villagers who reside in the coastal towns along the south front of the mountain for there are no residences on the top. The inaccessibility of the summit farms is a serious geographical handicap, for their operators are separated from them by a very steep and difficult mountain wall nearly 1000 feet high. This inaccessibility creates a real problem involved in the task of transporting the agricultural products down to the villages at the base of the mountain. The ingenious solution has been the construction of a jointly-owned and coöperative aerial tram with carrying baskets, whereby the field produce can, by hand power, be very quickly and cheaply lowered to the plains below. A four-strand wire cable supports the loaded baskets, while the empty baskets are pulled back over a two-strand cable.

It would seem to be a safe inference that the summit surface just described was at some prior period continuous with those similarly smooth, inclined plains which fringe the northern and western margins of the mountain. In the region intermediate between the two, stream erosion, subsequent to uplift and the probable northward tilting of the block, has destroyed the original surface of small relief and substituted a landscape that is relatively wild and rugged in appearance. Here and there in this intermediate region of sharp dissection there are, especially at the lower altitudes, scattered patches of tea and citrus, but in general timber and wild grasses dominate the scene (Fig. 23).

Seen from the alluvial plain near Shizuoka City the remnants of the original terrace surface around the northern and western circumference of Kuno recall to one's mind the triangular facets of a block mountain, but with much milder gradients. They are roughly like wide, blunt, flatirons with the pointed ends facing up-mountain and separated from each other by steep sided valleys. Not only are the comparatively smooth surfaced " facets " very obvious to the eye in a physical sense as compared with the dissected slopes above, but they are likewise distinct because of cultural contrasts, the shades of green common to growing crops as well as the grid pattern resulting from the multitude of cultivated patches, standing out in contrast to the back country of forests and grass where there is no regularity of pattern (Fig. 24).

These peripheral " facets " are identical in many respects with the cultivated surface on top of Kuno. The soils are similar in color and texture except that they seem to have considerably more gravel. Their degree of slope varies between 5° and 10° which is sufficient to warrant terracing in a rough way. However, tea is the chief but not the exclusive crop, and where it prevails, the hedges, planted as they are at right angles to the slope, are sufficient insurance against destructive slope wash. It is the vegetable fields which need more careful leveling. As one stands on the upper crest of a " facet " and looks down across its long dimension toward the alluvial plain it appears to be an almost perfectly smooth inclined plane. The opposite slope toward the mountain is precipitous and sharp and descends first to a rough hill country, partially planted to tea and oranges, but as the elevation increases farther to the east and the landscape becomes increasingly more rugged, agricultural land rapidly declines, with forest and grassland becoming prevalent. Those " facets " closer to the sea are more irregular in slope with greater dissection and more numerous clumps of trees, so as a consequence they seem to lack the expansiveness and the well cared for appearance of those farther north.

Steep-sided valleys, some of them containing trickles of water, descend by radial pattern from the mountain and separate the " facets " one from another. Along the steep lateral flanks of the " facets " the amount and kind of cropping seems to depend in a large measure upon the exposure. The slopes which face south, that is, the northern walls of the radial valleys, where the accumulation of solar energy is large, are likely to be planted in the sensitive citrus crop, in part at least (Fig. 26), while the cooler and windier northern flanks are more likely to be left in trees, or

FIG. 26—The south-facing flank of one of Kuno's "facets" planted in orange groves. Note the smooth, sloping upper surface.

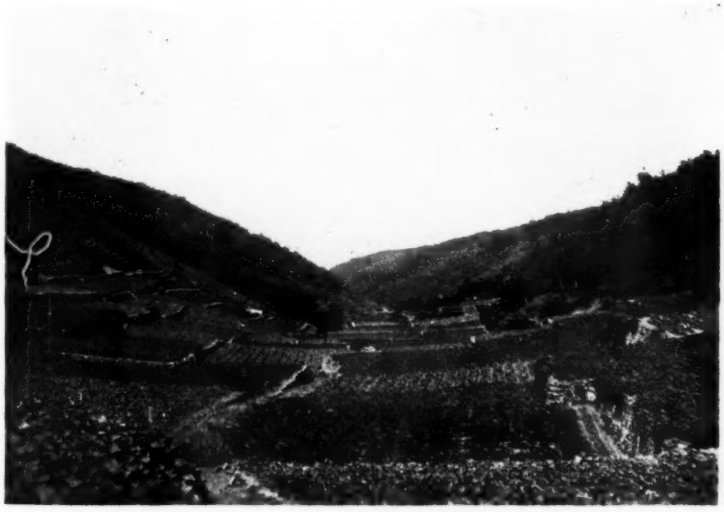

FIG. 27—Terraced vegetable patches in one of Kuno's radial valleys. Note that a protective mantle of trees and grasses covers the upper slopes.

planted in bamboo or tea. These same narrow valleys carry long thin lines of cultivated land far up the mountain, even to the very crest in a few instances. The floors of the lower ends of the valleys where water is available are devoted to paddy rice, the fields being artificially leveled to allow irrigation. Here ponds have been created by damming springs, or creeks or by merely providing artificial catchment basins for accumulating and storing the immediate run-off, and the water from these reservoirs is used for irrigating the paddies. As the gradients increase up-mountain, the width of the paddy fields becomes gradually less and the height of the retaining walls greater, but by this arduous method of field preparation, irrigated rice may be carried one-third to one-half the way up the mountain. Up-valley beyond the region of rice cultivation, where the water supply is lacking, the floors and lower side slopes are planted in terraced plots of tea, vegetables, and on the sunny slopes, oranges (Fig. 27). Abundant material in the form of smooth waterworn bowlders is available for constructing the outer or retaining walls of the terraced plots, and frequently even along the valley floors, walls three feet high are necessary for plots only 25 to 40 feet wide. One might well believe that in such valleys the crops would frequently be washed out and the fields destroyed through slopewash resulting from the heavy rains which fall in the coastlands of Shizuoka. The writer was assured by farmers working in these terraced fields that no such danger actually exists, for the porous subsoils permit only a very meager run-off. As a usual thing cultivation does not extend up to the summits of the valley sides, the higher elevations being left in trees as a protective measure.

Along the perimeter of Kuno, immediately adjacent to the lower margins of the "facets," there is a concentration of villages, elongated and continuous where the Tokkaido Highway parallels the mountain, as on the northwest, or in irregular and separate clusters where the highway is absent. The villages are at the zone of transition between the wet alluvium of the delta-plain and the diluvium of Kuno, where the first slight rise in elevation makes itself felt in superior drainage conditions, and from which position uplands and paddies are both easily accessible. In places villages occupy sites on the diminutive alluvial fans formed at the mouths of the valleys descending from Kuno. The small streams, usually dry except in rainy weather, are led out across their fans in diked channels to prevent them from doing serious damage in time of flood (Fig. 23).

Kuno Mountain is asymmetrical in that the relatively smooth and intensively cultivated " facets " which prevail on the lower slopes to the west and north are almost entirely lacking on the east, where waves and currents have succeeded in removing the outer margins of the mountain and subsequent stream erosion has carved the steepened flanks into a system of complex and irregular relief. Large, continuous, smooth-surfaced areas fit for upland crops are therefore lacking, and this comparative absence of unirrigated land is reflected in the dearth of villages at this base of the mountain. These irregular slopes facing Shimizu Bay are for the most part mantled with timber trees but with fairly numerous areas devoted to citrus orchards and tea. Such bush and tree crops which require less attention are a much more satisfactory type of cropping for steep slopes than vegetables would be, while at the same time these east flanks of Kuno have the advantage of being moderately well protected from the strong and cold northwest winds which are injurious to citrus trees (Fig. 32).

Facing Suruga Bay on the south, the truncated dome of Kuno presents a wild and confused topography. A cliff several hundred feet high marks the first stage in descent toward the sea while below this, and extending to within a quarter mile of the water's edge, is a somewhat less steep but more irregular, mass of talus. Short, steep-gradient, bowlder-strewn valleys are working headward into the mass of talus, their lower ends already being cut into the bedrock upon which the diluvial gravels rest. They are for the most part unutilized, their stony floors almost prohibiting it. Only at their extreme lower ends, where the detritus is somewhat less coarse, do vegetable patches begin to appear. In a few places, what appear to be small remnants of river terraces, below which the present streams have incised their channels, have been put to a similar type of utilization.

The Narrow Plain South of Kuno.—Kuno is bordered on its seaward front by a relatively narrow lowland (not over one-quarter mile wide) whose inner side is relatively steep and composed of material washed and slumped down from the mountain, while the outer one-half or two-thirds is wave-washed beach material. Upon this narrow strip of land there has developed the most intensive and specialized summer and out-of-season vegetable culture to be found in all Shizuoka Prefecture, and famous throughout middle western Japan. Almost continuous village parallels the highway which follows a medial position between mountain front

and sea along the narrow coastal strip, sufficiently far inland and elevated to be out of danger of inundation by storm waves. The inhabitants of the villages draw their livelihood from the meager resources of this closely circumscribed plain, and to a lesser degree from the cropped surface on the summit of Kuno, and the resources of the adjacent ocean. At an earlier time, before the era of vegetable specialization, when the extraction of salt from seawater was this region's particular economic interest, the villages south of Kuno were as famous for their poverty as they are now for their prosperity under the new economic regime for which by nature this limited area is so well suited.

A dozen or more short, torrential wet weather streams from the steep south face of Kuno are carried across this narrow coastal strip in elevated channels which rise fifteen to twenty-five feet

FIG. 28—The road passing under one of the elevated, diked, stream courses on the narrow plain south of Kuno.

above its general level but which are prevented, by means of artificial dikes, from inundating the valuable vegetable gardens. This in turn has led to aggradation in some of the channels, making necessary repeated dike elevations and so the vicious circle proceeds. The approach to these elevated stream courses is marked by a sharp increase of grade in the road as it rises to cross the channel, but in one instance at least the highway has been carried under the stream bed by means of a tunnel (Fig. 28).

In pursuing a specialized truck and market gardening type of agriculture the villagers are consciously utilizing to the best advantage whatever benefits the environment has to offer. The outer one-half to two-thirds of this lowland south of Kuno is composed of almost pure black, wave washed sand with quite a large admixture of small gravels. Such coarse, water-deposited soil in a humid climate is thoroughly infertile and quite useless without abundant applications of fertilizer. Nevertheless its warmth, dryness and porosity are mitigating factors, which in spite of its infertility recommend it for out-of-season vegetables. The soils of the slopes close to the face of the mountain, composed as they are of terrace materials, are somewhat heavier, but still containing much sand and gravel and are to be classed as light.

Coequal in importance with the soil factor is that of climate for the plain south of Kuno has an unusual plus anomaly in temperature, especially during the cold season. Its position on the south side, and just at the base of Kuno's sea cliff, and bordering the warm waters of Suruga Bay, where there is the maximum protection from low temperature importations, as well as an unusual accumulation of solar energy, both direct and reflected from the mountain wall, assures mild winters and an extraordinarily early spring which permits specialization in out-of-season crops commanding high prices.

Money is not spared by the cultivators in providing fertilizer for their crops of tomatoes, melons, onions, sweet potatoes, and cucumbers, and large quantities of fish guano, bean cake and night soil are applied by hand to the growing plants. Truly it may be said of this region that the soil serves only as an anchorage for the plant roots, the growing vegetables being supplied directly with food from above. Spraying machines are in common use to combat the ravages of insect pests and the numerous fungus diseases which prevail in this hot, humid climate. The droughty nature of the soils makes frequent irrigation imperative and since permanent streams are absent, water is obtained from shallow wells four to

ten meters deep. The water is commonly lifted by means of large wooden sweeps which are a familiar feature of the landscape, but gas engines are used to some extent, in conjunction with piping systems of hollowed bamboo which transport water to the vegetable patches.

Seaward from the villages and between them and the wave washed and tide washed outer beach, the vegetable patches are surrounded by fences of bamboo or other material to protect the crops from drifting sand and from wind. On the landward side of the villages the slope of the plain increases perceptibly and the black sands and gravels of the beach ridge grade into the brownish talus material from Kuno. On this side terracing becomes necessary and smooth water worn bowlders from the diluvium are brought into use in constructing the retaining walls.

The same patches which are devoted to summer vegetables, growing as many as three crops, are sown to grain in the late autumn, particularly to barley, for it, more than wheat, is better able to endure the droughty soils. The grain ripens and is harvested in May nearly a month earlier than in the Kwanto Plain on which Tokyo is located.

While this sandy strip of land south of Kuno is well known locally as a specialized vegetable area, its particular claim to fame in the large urban markets is through its out-of-season crops, particularly cucumbers and strawberries. On the basis of specialization in these two crops the plain may be divided into a western and an eastern section, the former devoted to growing early cucumbers under frames, while the latter specializes in strawberries. Small cucumbers are looked upon as a luxury and a delicacy in Japan and as a winter crop they bring exorbitant prices in the city markets. After the last crop of summer vegetables has been harvested in November, cucumber plants are set out in frames, covered with glass or oiled paper and tilted toward the south. The first young cucumbers are thus ready for market early in January and they continue to arrive up until April when the planting of cucumbers in the open fields begins (Fig. 29).

For no very apparent geographical reason strawberries replace cucumbers as the out-of-season crop toward the eastern part of the sandy plain. Here many of the patches are thrown up into long triangular ridges whose southern faces make approximately an angle of ninety degrees with the direct rays of the late winter and early spring sun (Fig. 30). The south sides of the ridges are faced with a layer of smooth water worn bowlders taken from

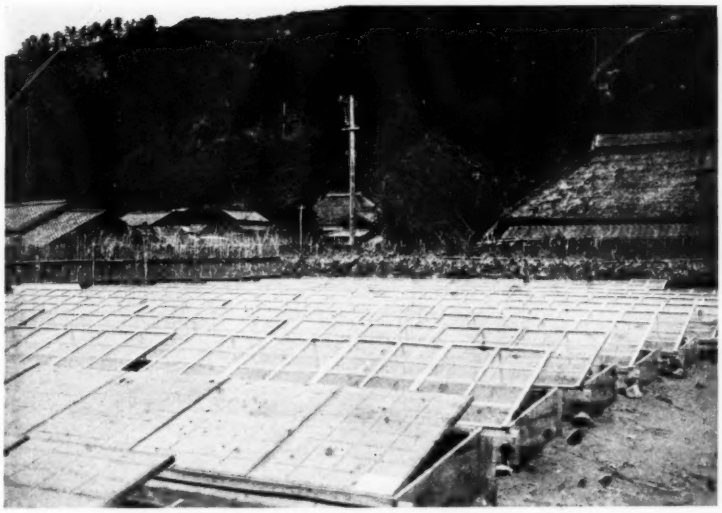

FIG. 29—Out-of-season cucumbers being grown under glass on the sandy strip south of Kuno. Note the fence made of bamboo and reeds which serves as a sand-break and wind-break. The sea cliff of Kuno rises abruptly back of the village.

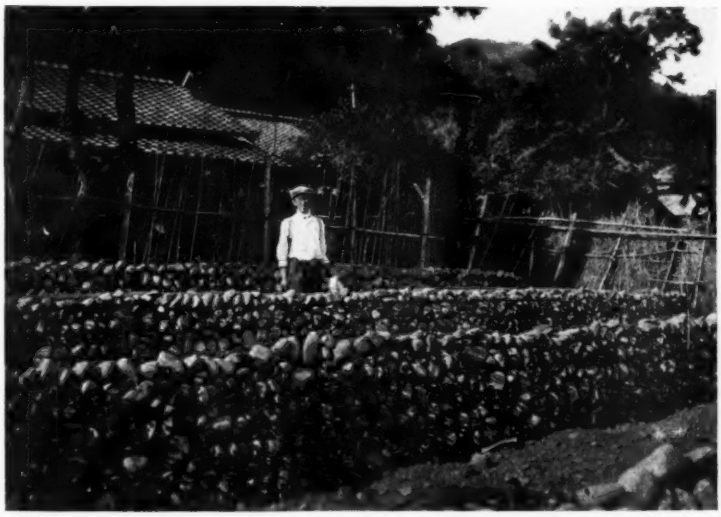

FIG. 30—Out-of-season strawberries grown on the south side of bowlder faced, artificial ridges on the narrow, sandy plain south of Kuno.

the adjacent diluvium, and the strawberry shoots are planted in the crevices between the bowlders so that while their roots are in the soil back of the stone facing, the plants themselves, as well as the fruit, are resting on the clean, warm stones. By this method the plants are given the maximum in sunlight and heat and at the same time the fruit is kept clean and dry with less likelihood of rot. Farther back toward the mountain on the steeper slopes, normal horizontal terracing is resorted to, strawberries being planted on the inclined retaining walls built of bowlders which slant somewhat up-slope, while the horizontal surfaces are devoted to the usual vegetable crop. This region begins to ship strawberries to the city markets during the middle of the winter and by utilizing different varieties is able to maintain its market until March or April.

c^2 *Makinohara*

The terrace upland of Makinohara is the focal center of tea growing in Japan. Significant of the preeminent position which Shizuoka Prefecture holds in tea and of the more specific localization of that crop at Makinohara, is the fact that on the latter's flat upland surface, in the midst of large expanses of tea gardens, have been established the National Tea Experiment Station of Japan as well as the prefectural branch station.

This remnant of diluvium, resting upon a much broader and maturely dissected platform of Tertiary rock, rises sharply above the alluvial plains to an elevation of approximately two hundred meters at its northern boundary. The writer is not aware how much of the total elevation is hard rock and how much is terrace gravels, but the latter deposit seems to be at least several scores of feet deep. Its flat topped crests, although they appear nearly level to the eye, pitch southward toward the sea with a ten-foot-per-mile gradient, reaching their southernmost extent in Cape Omae. Numerous small streams, whose valley flood plains support the customary rice crop, have cut headward into the basement rock and the unconsolidated terrace gravels, thoroughly dissecting the upland and all but obliterating the original flat surface (Fig. 31.) At the present time only along the crests of the three or four major divides are there any remnants of what must have been formerly a more extensive upland plain, but it is upon these irregular remnants, varying from a fraction of a mile to a mile in width, and ten to twenty miles long that there are to be seen probably the largest expanses of contiguous tea plots anywhere in Japan.

FIG. 31—The intensively cultivated flat top of Makinohara, flanked by steep-sided ravines and gorges.

FIG. 32—Distribution of tea within Shizuoka Prefecture. Each dot equals 2000 kwan (1 kwan = 8.267 lbs.) of tea. Note the concentration on the lower slopes of the mountains and on the diluvial terraces.

If a map of land utilization were to be superimposed upon one purporting to show land forms, the areas of tea culture would be found to coincide almost perfectly with the flat tops of the major divides. A serious attempt is being made to thwart a further encroachment of the canyon-like valleys upon the upland by keeping the precipitous flanks of the terrace well mantled in timber and wild grasses.

A closer analysis of the upland landscape of the terrace shows it to be a flat or very gently undulating surface, in no parts having sufficiently steep slopes to make washing an item. Yet in spite of its flatness there is no problem of drainage, for the porous sand and gravel layers underlying the ash soils on the surface allow rapid percolation (Fig. 33). From some points of vantage one

FIG. 33—A soil and subsoil profile on Makinohara. The ash top soils are relatively high in humus content. The subsoils are poorly assorted sands and gravels.

can allow his eye to travel off over scores of acres of smooth rounded tea hedges with scarcely a single variation in culture (Fig. 34). This is not one individual's plot, however, for the average size of the tea farms is in the neighborhood of one acre or less. It is frequently possible to detect the limiting boundaries of the individual fields by the pattern or "grain" of the hedge rows within the adjacent fields. This promiscuous arrangement is dissimilar to methods followed on steep slopes where contour planting is necessary in order to prevent active wash and gullying. But on Makinohara where no such danger exists, the culture pattern may depend upon the shape of the field, or even more likely upon the whim of the planter.

FIG. 34—Large uninterrupted areas of tea plantations are characteristic of the flat upland surface of Makinohara. Note the indistinct and irregular profile of the mountains in the background.

The individual tea bushes, each so-called bush in reality a clump of shoots, are not so evident in a mature and carefully pruned tea garden, for they are cut and trimmed in such a fashion as to develop hedges, whereby clipping the young leaves with shears becomes relatively easier than it would be from separate and individual bushes. The usual distance between the centers of the rows is five to six feet but in mature gardens the hedges expand

so that there is just sufficient room for the pickers and cultivators to move about between them.

Dotting the upland surface and set down in the midst of tea gardens are numerous small huts, the entire building being sometimes made of thatch. The smaller ones belong to the owners of the fields and they may be used for a number of purposes, including the storage of field implements, shelter for the tea pickers at lunch hours and temporary resting places out of the direct sunlight for baskets of green leaves until they can be carried to the firing establishment. The somewhat more pretentious huts, frequently with a pennant flying above them to indicate their special use, are the field headquarters of the green leaf buyers (Fig. 34).

Makinohara is the most exclusive tea garden that the writer has seen anywhere in Japan. The samples of this upland which were visited would seem to indicate that crops other than tea are relatively insignificant, much more so than on Kuno, for instance, or on any of the other terrace lands. Here and there are patches of the usual upland vegetables but they are not sufficiently numerous to allow one to believe that they are being grown for commercial purposes. Much of this upland is in the possession of villagers living on the adjacent alluvial plains and the number of residences on the crest of the terrace is relatively few. Large villages are entirely lacking, but there are some scattered houses and now and then a cluster of dwellings alongside the highways which follow the flat-topped divides. The lack of villages on most of the terrace lands reflects no doubt their relative inaccessibility, for the approach to them from the plains is by means of difficult grades. It offers, therefore, a sum total of less inconvenience for the individual farmers to walk to and fro from their lowland homes to their upland farms than for the activities and life of a whole village to be handicapped by such a segregation. A complementary explanation is associated with the relatively late agricultural development of the diluvial uplands for land that could not be irrigated and was therefore unfit for paddy was not held in high esteem until fairly recently.

The extreme southward projection of Makinohara, forming the Omae Peninsula, exhibits a landscape somewhat in contrast to that of the normal high terrace previously described and may be considered as a sub-region of it. The high terrace terminates at a relatively sharp declivity some four or five miles north of Cape Omae and from there southward a distinctly lower terrace prevails. The latter is in the form of an intermediate step, about

forty meters in elevation, between the coast and the higher upland farther north. A number of flat bottomed, steep sided valleys have been carved into the lower terrace but a much larger proportion of the original flat top still persists than is true in the case of its more elevated neighbor. In cultural forms the contrast still persists, for the lighter, sandier soils of the lower upland are less satisfactory for tea gardens, and although that perennial is not absent, it occupies much less area than do vegetables. The Cape Omae Peninsula is particularly famous as a region of commercial sweet potato production, large quantities of the dried product as well as the fresh crop being shipped to various parts of Japan, but more especially to the higher latitudes where they are not grown. The annual shipment of dried sweet potatoes from this region is valued at $750,000.[43] Man has here very definitely related his economic life to the peculiarities of the environment, for sweet potatoes find their optimum conditions in warm sandy soils while the natural drying of the crop is facilitated by the prevailingly strong winds of this exposed location.

The irregular and dissected flanks of Makinohara are for the most part left in trees and wild grass. Here and there in favored locations a few patches of tea or citrus groves are to be seen but they are the exception. On the extreme western margin of Makinohara, bordering the Ota Valley, patches of diluvium are to be found at low elevations and tea plantations are here more numerous.

The lowlands bordering Makinohara along Suruga Bay and the Pacific are narrow, sandy, and unfruitful. Only where small streams have cut flat bottomed valleys back into the uplands are there any considerable areas of good agricultural land. The strong sea winds and the extensive development of sand-dunes along the Pacific Coast west of Cape Omae have entirely discouraged the development of villages, but north of Cape Omae, bordering the quieter waters of Suruga Bay the dunes are absent and villages are numerous. The inhabitants of the coastal towns are primarily tea farmers, cultivating land upon the adjacent uplands, or are engaged in fishing. Only meager and relatively poor crops are produced in the swamp and sand of the narrow plain itself. Sagara and Kawasaki, two of the largest villages, have attained a degree of renown as tea processing and fishing centers. At the former

[43]Information from Mr. Takaishi, Director of the Prefectural Agricultural Experiment Station in Shizuoka City.

location there is an establishment for extracting iodine from seaweed, which is explanatory of the extensive areas of drying racks bearing long streamers of black kelp along the outer beach in front of the village (Fig. 35).

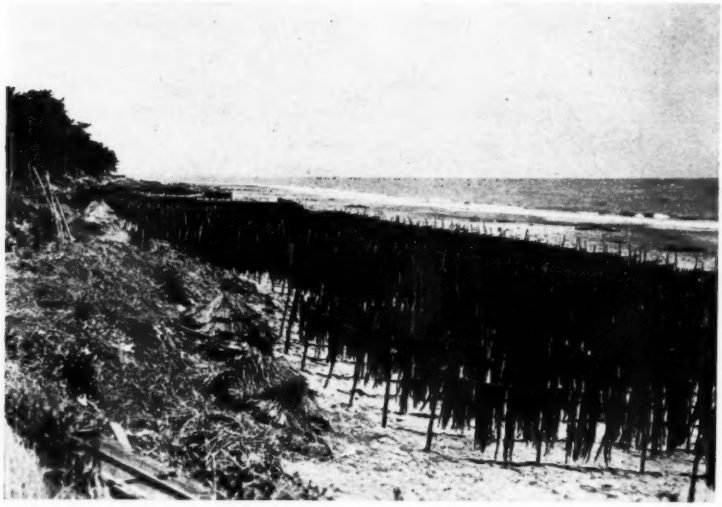

FIG. 35—Kelp drying along the outer beach at Sagara near Cape Omae. The product is used in an adjacent iodine factory.

The Tea Industry[44]

In Japan the name Shizuoka is almost synonymous with tea for that prefecture produces approximately one-half of the total crop of the country. Nowhere in Nippon does specialization in this crop reach such a high degree of importance; in fact the economic well-being of the prefecture is intimately related to its current prosperity. The remarkable concentration of tea gardens in Shizuoka Prefecture is not clearly related to any one particular and striking element of the environmental complex although the whole complex seems to be at least attractive. The favorable combination seems to be a relatively large amount of ash-covered upland in a region of exceptionally heavy, warm season precipitation.

[44]Under this topical heading it is proposed to discuss certain aspects of the tea industry of Shizuoka which are common to the industry as a whole and not necessarily peculiar to any particular region. That the author has chosen to develop this phase under the regional heading of Makinohara merely reflects the paramount position of that geographic region in tea.

The tea bush apparently has contradictory requirements, for while it thrives best in regions with heavy rainfall and high humidity, it is at the same time intolerant of poor drainage. This dual need can best be satisfied in most tea regions by growing the bush on slope locations where run-off is rapid, with the added advantage that crop competition is much less severe on these marginal lands than it is on the lowlands. Examples of such tea lands in Shizuoka are the foothills of the sedimentary-rock mountains, previously described. They are, however, usually under the handicap of lacking in sufficient depth and quality of soil to allow satisfactory development of the root system. The food supply is meager and the danger from drought more serious, these less satisfactory conditions being reflected in the smaller size of the tea bushes and the less abundant crops of leaves. But in Shizuoka the combination of adequate drainage in a region of heavy rainfall is found to a marked degree of perfection on the moderately sloping, or even flat surfaces, of the numerous diluvial terraces and the foothills of the ash cones of Fuji and Ashitaka. In these latter locations drainage is assured thru the porous nature of the soils and subsoils while at the same time great depth of soil and moderate slopes complete an environment which is semi-ideal. In the porous soils of the terraces the deep tap root system of the tea bush is allowed to attain its maximum development, assuring against danger from drought and resulting in healthy bushes with large yields of leaves.

The top soils of the terraces are usually volcanic ash loams with varying amounts of sand and gravel, and in places of a high humus content. It should be strongly emphasized that it is this ash veneer mantling the infertile sand and gravel strata which compose the terraces that permits these uplands to be utilized for agricultural production. The writer has seen similar terrace uplands in other parts of Japan where explosive volcanic activity has been absent and where as a consequence no ash mantle masks the fluviatile terrace layers and agricultural utilization is practically nil. The proximity of Fuji Volcano in all probability accounts for the large amount of volcanic ash on the uplands of Shizuoka. The soils on the lower slopes of Fuji and Ashitaka are pure subaerially deposited volcanic ash and therefore without gravel. They are consequently somewhat less porous than those of the terraces but not to a serious degree for the ash here rests upon a fragmented lava base so that surface drainage is not common.

Tea men in Shizuoka are almost unanimous in their beliefs that soil characteristics are of paramount significance in creating contrasts in flavor, aroma, and color in teas from various districts. A large amount of humus in the soil is said to produce dark green leaves; red clay soils develop brownish yellow leaves. The Kanaya region in which red soils predominate is known for middle quality strong tea with poor color; the teas of the Abe district are of high quality; those from the foothills of Fuji and Ashitaka are weak, and good neither in taste nor aroma but satisfactory in color.[45] To be sure these are empirical statements and the writer has not been able to assure himself of their accuracy or value. One thing that gives some degree of credence to the above statements is that these reputed qualities of teas from certain districts are said to be sufficiently consistent so that tea exporters are able to synthesize their various commercial blends based partly upon these standards.

When tea manufacturers in Shizuoka City are faced with the inquiry as to how one may interpret Shizuoka Prefecture's ranking position in tea production they are inclined to answer in terms of climate. Specifically which climatic element or even combination of elements is critical is not so easy to prove. The winters here are relatively warmer than in many adjacent regions but winter temperatures, unless unusually severe, are not very significant in tea culture. Summer temperatures are high but not markedly more so than in adjacent regions. In hours of sunshine Shizuoka does rank remarkably high (2240 hours a year) and this factor together with the extraordinarily heavy precipitation of eighty inches, most of it falling during the growing season for tea, are probably of some significance.[46]

To recapitulate, therefore, it seems like a tenable hypothesis to assume that Shizuoka has been consciously selected by tea growers, partly at least because of the prevalence in that prefecture of extensive areas of well drained, ash covered uplands in combination with a relatively sunnier, but at the same time more rainy climate than is usual for most parts of Japan.

Cultivation and Processing.—Many of the upland soils are relatively low in plant foods, this being occasioned by the low fertility of the original ash deposits as well as by the subsequent active

[45]C. R. Harler, "The Cultivation and Manufacture of Tea in Japan," in *The Spice Mill,* XLVII, July, 1924, pp. 1346-1350.

[46]See tables on pages 140 and 174 for more detailed climatic data.

leaching due to the warm and abundant rains. As a consequence of the low content of soluble minerals in the soil, it is necessary that all upland crops, including tea, be heavily fertilized. In the production of tea the cost of manures is the single largest item of expense totaling usually between thirty-five per cent and forty per cent of the entire expenditure.[47] During the summer season mulches of grasses or weeds are frequently spread over the ground between the tea bushes in order to protect the soil from rapid evaporation, to hamper the growth of weeds, and when later plowed under, to serve as a green manure. The principal manuring is done in autumn after the last picking, but fertilizers are usually applied to the soil immediately surrounding the tea bushes in late March and again after the first and second pickings for the purpose of immediately producing an excess of new leaves, the practice being known as " flushing."

Three pickings a year are the usual practice in this part of Japan with sometimes a fourth, although this is not recommended because of the injury which late picking does to the plant. In the first picking, which occurs in May, the upper three to five leaves of the new shoots are clipped. The first picking is much the largest and the most valuable in Shizuoka, yielding normally 47 per cent of the year's crop by weight and 60 per cent by value. The second picking, usually in June, shows a decrease in both quantity and quality over the first, providing only 29.1 per cent of the annual crop by weight and 21.8 per cent by value, while the respective figures for the third picking in July or August are 23.7 per cent and 18.1 per cent. Where there is a fourth clipping of the bushes the yield is relatively insignificant.[48]

Japan tea belongs to the class known as green tea, which is prepared for a large and exclusive home market and a restricted foreign consumption, largely in America. The flavor, color, and aroma which distinguish green tea are imparted to it largely through the processing methods although it is stated by the Japanese that the tea bush of Japan does not produce leaves which are well adapted to methods of black tea manufacture. The chief and essential point of contrast between the black teas of South Asia and the green teas of China and Japan, is that the latter are subjected immediately after being picked to a brief period of great heat which completely destroys the enzymes of fermentation and

[47]Data from National Tea Experiment Station on Makinohara.

[48]Ibid.

renders it possible to conserve the natural color of the leaf and give it a distinct aroma and flavor.

Fresh green leaves clipped from the bushes are usually processed the same day that they are cut. Care must be taken not to bruise or injure them, otherwise fermentation proceeds at a rapid rate and the aroma which is distinctive to green tea will be lost. Baskets containing fresh leaves are not allowed to rest upon the ground for tea at this stage is very susceptible to earth odors, nor are they left exposed to direct sunlight. The first stage in processing consists of putting the leaves thru a few seconds of steaming which destroys the active agency of fermentation and gives them a certain flaccidness necessary for the rolling processes which follow. The subsequent successive rollings and dryings give the leaves proper shape and form and decrease their moisture content. The product at this stage is known as " green underfired tea." Due to the fact that the manufacturing period for tea in Japan is so short, large expensive factories are not economical and numerous widely dispersed small plants suit the situation better. Even the largest handle not more than 12,000 pounds of raw leaf a day while the usual daily capacity is 2,400 to 4,000 pounds.[49] Numerous small plants offer a second advantage in making it unnecessary for the perishable raw leaves to be moved long distances.

The underfired green tea is further processed in so-called refiring factories where it is refired and blended both for home consumption and for export. Through variations in method, differences in quality and style are produced to suit the demands of the several markets. Where style and appearance are the chief requisites, basket firing is resorted to, in which process the underfired leaves are spread out over a bamboo tray inside of a solidly woven, split bamboo basket which is hung over a brazier containing live charcoal banked with ashes. Every five or ten minutes the leaves are gently stirred by hand to assure thorough drying. The basket-fired product has reputation largely through the long, slim, unbroken, needle like leaves. In pan-fired tea about twenty pounds of leaf are put into each of a whole battery of large rotating metal pans below which are charcoal fires. Rotating paddles inside the pans agitate the tea and keep it from scorching. The result of this form of processing is a product of superior quality but due to its broken nature, less fancy than the basket fired tea. It is the former which enters more largely into foreign trade, the

[49]Harler, op. cit., p. 1346.

American market buying it in seven times the quantity that it does the fancy and more stylish product.

Shizuoka City, the capital of the prefecture, has become the center for tea manufacturing and exporting in Japan. This situation seems to reflect the advantages which accrue to the business from being in close proximity to the regions of raw leaf production. Up until twenty or twenty-five years ago processing tea for export was done entirely by foreigners in the foreign concessions of Yokohama and Kobe.[50] At that time a number of small Japanese refiring plants were established in Shizuoka City and its neighborhood, attracted there presumably by the abundance of the tea crop. This native refired tea was then offered to the foreign merchants in the port cities together with the raw leaf. As Shizuoka grew as a refiring center, gradually the foreign exporters came to make their headquarters there for a few months each year in order to buy finished teas which they blended and packed for shipment abroad. The advantages involved in this shift of location are associated with (1) a decrease in the cost of local freight on shipments of underfired tea; (2) a saving on boxes in which this semifinished product was sent to Yokohama and Kobe; (3) the greater ease in obtaining tea in fresher condition; and (4) the fact that the transactions between exporters and refirers can more easily involve smaller amounts of tea which makes it less possible for quantities of undesirable leaf to be included without its being detected. At least two of the large exporters in Shizuoka City buy the green tea and do their own refiring, believing that by so doing they are better able to maintain uniformity in their standard grades. Most of the exporters, however, buy their tea already fired from native plants and do only the blending and packing within their own establishments. The writer was unable to obtain data showing the exact distribution of refiring plants within the prefecture but men in the business estimated that probably one-half the total number were in the capital city where over ninety per cent of the export tea is prepared for overseas shipment. The refired and blended product is

[50]Even at the time that Yokohama and Kobe were the chief refiring and export centers, Shizuoka Prefecture was supplying seventy to seventy-five per cent of the exported tea. At the present time, according to the Shizuoka-Ken Tea Refiners' Guild, Shizuoka produces nearly the whole of the tea export. In 1905 Mr. G. Harasaki in Shizuoka City invented a machine to replace the old hand methods of refiring and established a plant for refiring by machinery in Shizuoka in the heart of the producing area. Other native tea dealers followed suit so that the American buyers found it to their advantage to locate in Shizuoka City as well.

shipped in bulk packed in light wooden boxes (eighty pounds net), lined with leadfoil and covered with Chinese matting, and also in pound and half-pound cartons. The chests of tea are sent from Shizuoka to Shimizu for export mostly on the electric railway, but sometimes on motor-propelled or horse-drawn vehicles.

The tea exporting business is relatively concentrated in the hands of a few companies, the five largest with headquarters in Shizuoka City shipping in 1927 over 19,500,000 pounds out of the total 21,665,127 pounds exported, valued at 10,466,423 yen, while two of these firms handled over one-half the total.[51] The 21,665,127 pounds leaving Japan for foreign lands were divided among the several Japanese ports as follows: Shimizu 20,940,465, Yokohama 723,574, Kobe 1,088.[52] Thus ninety-seven per cent left by way of Shizuoka's port, this concentration reflecting an immediate hinterland specialized in tea production and tea processing. The port of Shimizu is only eight to ten miles distant from Shizuoka City, the refiring and export center, and is connected with it by the Tokkaido Railway and Highway and by an electric tram line. American, Canadian, and Japanese transpacific boats, about one hundred in all, make Shimizu a port of call during the summer months in order to obtain this seasonal cargo. The harbor is not sufficiently deep, nor the dock facilities adequately developed, to permit steamers to approach the wharves so that transfer of freight is done entirely by lighters (Fig. 36).

Of the 21,665,127 pounds of tea shipped overseas in 1927, 17,750,228 pounds were sent to the United States (New York 6,136,689; Chicago 9,269,238; Pacific Coast 2,344,301), 2,908,-699 pounds to Canada; 1,006,200 pounds to Russia, and 24,000 pounds to Europe.[53] It is very apparent that the American market is the *raison d' être* for the Japanese tea export trade, and that market is at the present time declining. The high-water mark in export was reached in 1903 when nearly 46,000,000 pounds were sent overseas, and again in the years 1916-1918 inclusive when the annual export exceeded 40,000,000 pounds. The falling off in foreign shipments reflects not only a decline in the quality of Japanese teas, which has prejudiced foreign markets against this product, but also the increasingly severe competition of black teas from tropical South Asia where labor is less expensive and where

[51]Data obtained from the Shizuoka-Ken Tea Refirers' Guild.

[52]Ibid.

[53]Ibid.

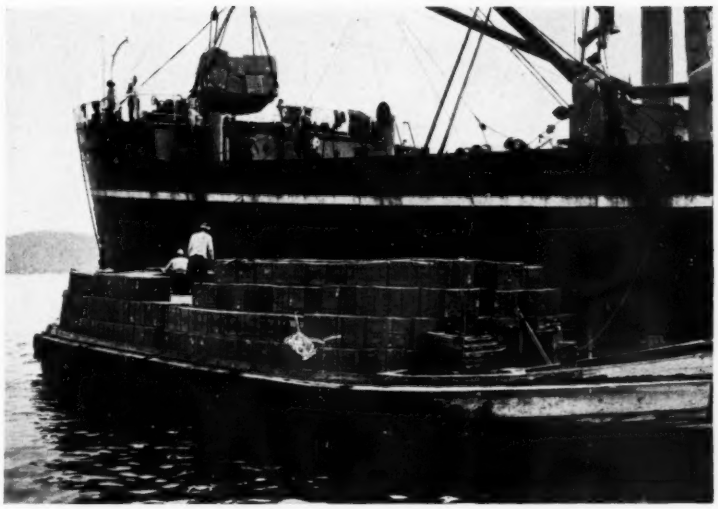

FIG. 36—Loading boxes of tea from lighter to ocean steamer in Shimizu harbor.

the all-year growing season, permitting more numerous pickings, results in a larger yield of leaves per unit of area than is true for intermediate zone Japan.

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c^3 *Bandenohara*

Bandenohara is quite similar in structure, materials, and forms of landscape to Makinohara and the other diluvial terraces in Shizuoka Prefecture. It stands out boldly above the alluvial plain of the Tenryu, rising in steep tree-covered slopes, almost precipitous on its western flanks where the river at one time swung laterally against its walls, to elevations of nearly four hundred feet at its innermost margin but sloping seaward with a gradient averaging thirty feet per mile. On the southwest it terminates in a distinctly lower bench, more regular in surface features than the main terrace, and more completely utilized. It probably represents an erosional terrace carved by the Tenryu. The village of Nakizuma occupies a strategic location on the extreme end of this bench where it is crossed by the Tokkaido Railway and Highway, the elevation here being only ten to twenty feet above the alluvium, so that the terrace is much more conspicuous because of its ruddy soils and upland crops than it is for its

height. In the shallow cuts along the railway the usual sand and gravel layers are exposed, but these are mantled on top by a covering of rust-colored volcanic ash as is the higher terrace as well.

Seen from the plain on the Tenryu side, the crest of Bandenohara presents a regular and even skyline, but closer examination of the upland surface shows it to have been made moderately uneven by slopewash and wet-weather streams. On Makinohara the changes in slope are very abrupt and sharp so that one can stand on the brink of the even-surfaced crests and look down into deep canyon-like valleys. This is not true to the same degree on Bandenohara except on the extreme eastern and western margins, and while a greater width of upland surface still persists on Bandenohara, it is characterized by more moderate irregularities.

The utilization of this more irregular surface of Bandenohara is not nearly so complete nor mature as it is on the terrace lands previously described. Tea gardens, mulberry patches, vegetable plots, and areas of coniferous woodland dominate the landscape, the latter vegetation prevailing on the more irregular slopes but occupying other sites as well where slope conditions are not an unfavorable item. In some sections it appears that the land has

FIG. 37—A young tea plantation on the somewhat irregular surface of Bandenohara. Young conifers are to be seen in the background.

only recently been cleared for the tea and mulberry bushes are small and appear to be young. Frequently these cultivated patches are isolated and appear as scattered clearings among the trees (Fig. 37). Around the margins of some of the fields are to be found large heaps of smooth water worn bowlders which have been recently removed from the soil. It would appear therefore that Bandenohara is gradually being brought under more complete and intensive utilization.

Except at its extreme southern end, where the elevation is low, no villages exist on the top of the upland although scattered farm houses are not uncommon. The disadvantages possessed by these diluvial plateaus as village sites have already been noted. Of the main traveled highways Bandenohara has none, except that the Tokkaido road crosses the seaward tip of the lower terrace as does also the railroad, while there are poor secondary roads on the higher upland which can be used by carts.

The lower bench of the terrace along the southern margin upon which Nakizuma is located is almost completely utilized for tea and vegetable gardens. Its more regular surface, less stony soils, easier accessibility, and closer proximity to the lowland villages make it altogether a more desirable location than is the main terrace. Villages have located upon its surface, and highways cross it in various directions.

c^4 *Mikatagahara*

Mikatagahara, the most western of the diluvial terraces in Shizuoka, is, as its name indicates, a triangular-shaped upland, its base toward the south and facing the sea. On all sides it rises from low alluvial lands or water surfaces by steep or even precipitous slopes to an almost monotonously level surface, over three hundred feet in elevation at its northern apex, which dips gently southwestward at a mild gradient of about thirty feet per mile, and ending on its seaward side in abrupt and bold wave cut cliffs seventy-five to one hundred feet high. Its southern and western flanks have been deeply incised by stream erosion resulting in long projecting flat-topped ribs of terrace, separated by steep-sided alluvial floored valleys, or on the west, by arms of Hamana Lake. On the east, lateral erosion by the Tenryu has resulted in less ragged margins and the contemporaneous development of meander cusps and a number of erosional terraces. The ash-covered crown of the upland, the most extensive of any of the diluvial terraces in Shi-

zuoka, and to the naked eye appearing almost absolutely flat, is for the most part lacking in cultivated land, a mantle of woodland and wild grasses covering the greater part of it.

The material evidences of man's occupancy of Mikatagahara are not as numerous as they are on most of the terrace lands. Villages are almost entirely absent although on the extreme southeastern angle of the plateau the residential section of Hamamatsu, the metropolis of the prefecture, has expanded from the Tenryu Plain up over the rim of the upland and out to the north along one of the main thoroughfares. This principal all-weather highway, originating at Hamamatsu, crosses the upland from southeast to northwest, while a number of tributary routes, most of them unfit for motor-propelled vehicles, spread a thin network over the upland, the individual roads quite uncontrolled by surface features and consequently following very straight and direct courses. A narrow gauge, privately owned railway, with diminutive rolling stock, strikes north across the upland surface from Hamamatsu and connects the villages in the subsequent valley to the north of Mikatagahara with the main Tokkaido Line. Scattered houses are in evidence along, or in the general vicinity of, some of these routes of communication but never are they sufficiently numerous or compact to warrant the name of village. This landscape pattern of scattered individual dwellings is rather unusual in Japan and seems to be frequently characteristic of new settlements. In the east-central part of the Mikatagahara upland, where there is a rather marked convergence of routes of travel, there is likewise a concentration of individual farm homes, each one surrounded by a small area of cultivated land. Inquiries seemed to indicate that these were homes of tenant farmers.

Not only in relatively close proximity to some of the highways on the upland, as previously described, but likewise upon the flat-topped ribs or prongs of terrace to the south and west, where the intervening alluvial-floored valleys have attracted the establishment of villages on the lower valley sides, are there considerable areas under cultivation. These outer margins of the upland, besides possessing the advantage of proximity to the populated alluvial plains, are likewise favored with soil advantages, for while the soils of the plateau as a whole are classed as loamy clay or clay, those of the terrace prongs to the south are gravelly and sandy loam. The usual upland crops, viz.; mulberry, tea, vegetables, and winter grains predominate in the agricultural landscape of Mikatagahara but there are likewise numerous peach orchards and vineyards,

FIG. 38—A peach orchard and vineyard along the narrow gauge railway which crosses the flat surface of Mikatagahara from north to south.

forms of culture which are peculiar to Mikatagahara among the terrace lands (Fig. 38). The relatively large acreage devoted to fruit culture is rather remarkable considering the exposed nature of the plateau, for while it is probably warmer than the lowlands and less subject to radiation frosts, it is open to a free sweep of winds from all directions which are at times injurious. The writer saw numerous evidences of wind damage among the peach orchards, where young trees were broken or even uprooted. In spite of the fact that the upper soils are a clay or loamy clay, the porous sand and gravel beds which underlie it preclude any danger from water logging on cultivated soils, a condition of which these fruits are not tolerant. Some farmers who were questioned regarding the quality of the soils even complained of them being droughty.

Proximity to the market of Hamamatsu has led to the recent establishment of a dairy farm on the flat upland of Mikatagahara, the only place adjacent to the city where relatively cheap land is still available. The owner of the farm, a recent graduate of the agricultural college at Sapporo in Hokkaido, has acquired a plot of ground about 2½ acres in area, upon which he has built a small barn to house his herd of eleven Holstein cattle, and another shed where the milk is pasteurized and bottled for sale in Hamamatsu.

The cattle are allowed to run in a small fenced yard adjacent to the barn but there is no pasture, the wild grass of the upland being quite useless for grazing purposes.

Along the main road, striking north from Hamamatsu, and somewhat less than a mile from the city, is a permanent army camp with barracks and drill fields, while still farther north on the broader portion of the upland there has been established a military flying field, with an aerodrome, the flat surface and hard compact virgin soils recommending it for that use.

It appears somewhat incongruous in a country like Japan, which is so hard pressed for food, to find such a large extent of level upland as Mikatagahara so meagerly utilized for agricultural crops and so extensively given over to woods and moorland. The immediate, and perhaps the ultimate, explanation for this anomaly is related to the problem of ownership for up until a few years ago much of this upland was designated as a Crown holding, and therefore in the hands of the Imperial Family whereby its intensive utilization was thwarted. It was suggested from more than one source also, that the hard, compact, infertile, ash soils, strongly acid, may have been further cause for retarded development. In their virgin condition the soils are extremely hard, so much so that the Japanese find it almost impossible to break them with a plow and are compelled to resort to a mattock for the first turning. Upon one occasion after nearly two days of steady rain, the writer took the opportunity of testing the upland soils with a mattock but he found it still very resistant to penetration and so hard and brittle that it flew out in small chips. On these unloosened virgin soils rainwater is scarcely able to soak into the ground and in the flat areas it may stand on the surface several inches deep after a heavy rain, and this in spite of the sand and gravel subsoils. Whether the original soil conditions of the other more extensively cultivated terraces in Shizuoka duplicated those of Mikatagahara the writer is not sure, but he is inclined to believe that such was the case, for soils which have been under cultivation on Mikatagahara for some years are of good tilth, and in general similar to those of Kuno and Makinohara.

After the very difficult task of the primary breaking of the soil has been accomplished the land is still infertile and unsatisfactory for a number of crops. Spraying with slaked lime is a common practice whereby acidity is corrected and conditions making for good tilth are prospered. For several years after the first plowing these soils are very inferior and quite unsatisfactory for grain or

vegetable crops. Soil tolerant, and especially acid tolerant, plants, such as tea, mulberry and certain varieties of fruit trees are therefore frequently the "first crops" on newly broken upland soils, the farmer feeling indisposed to allow the land to lie fallow until it is properly ripened and fertilized for the sowing of more exacting crops. Enormous quantites of manure are lavished upon these ash soils; at certain times of the day the roads are so filled with fertilizer carts bringing night soil and other manures out from Hamamatsu that progress in a motor vehicle is very much retarded. Shallow cement cisterns for storing and ripening the fertilizer are numerous on the upland farms and the stench of fertilizer is at times almost overpowering (Fig 39).

FIG. 39—Fertilizer wells on Mikatagahara.

It is not to be disputed, therefore, that such a region as Mikatagahara does offer obstacles to the pioneer agriculturist which react in such a way as to retard its rapid utilization. Such, in fact, is the history of upland agriculture in Japan, for everywhere it has had a much more recent development than was true for the delta plains. The fact that other terrace lands with very similar site characteristics within the same prefecture are being much more extensively used than is Mikatagahara is the fact that requires explanation, and that is found, the writer believes, in the fact of Imperial ownership.

Within the past few years the Imperial Family has transferred its rights of ownership in Mikatagahara to the prefectural government, and it, in turn, is parceling out the land to villages which sell or rent it to their citizens. It is anticipated therefore that an accelerated rate of agricultural utilization will be the result of this new ownership. Semiserious consideration is being given to a plan whereby water drawn from the Tenryu River at a point much higher upstream can be brought to the crown of this adjacent upland so that it will be possible to convert it into paddy fields. Since the national government grants subsidies to undertakings which have as their objective the reclamation of wasteland for rice culture, this consideration has weight. The director of the Prefectural Agricultural Station in Shizuoka City is opposed to the scheme which seeks to irrigate the terrace, believing that the most satisfactory results will be obtained with the usual upland crops. Not only would the irrigation project be expensive, but the heavy clay soils and the porous subsoils are certainly far from a satisfactory combination for paddy-rice culture. Apparently, also from the considerable areas on the Tenryu Delta-Plain which are devoted to unirrigated crops, there is already enough rice land and to spare in the immediate locality so that a further increase in paddy area would force the grain to be sold on the market as a commercial crop. Considering the immense amount of hard and distasteful labor which rice requires, as well as its low cash value per unit of area as compared with vegetables or even tea, it is quite understandable why farmers are anxious to plant only just enough land in rice to supply their own families with food. Beyond this amount their lands can be more profitably devoted to unirrigated crops.

3. The Irrigated Delta-Fans

Typical of Japan as a whole, the population of Shizuoka is mainly peripheral, agricultural as well as industrial life being largely concentrated on the discontinuous alluvial plains which fringe the outer margins of the mountain and terrace lands. Completeness and intensiveness of cultivation, the multitude of villages and cities, the network of communications, all testify to a focusing of human energy upon the recent alluvium where favorable site conditions expressed in terms of more fertile soils, slight relief, and available running water for irrigation have attracted settlement. Fifty-one per cent of the total cultivated area in Japan is paddy land, while the rice crop more than equals the combined value of

all other products from the soil. Due to the relatively large amount of terrace upland in Shizuoka, the similar figures for area and value in that political subdivision are somewhat less, forty-seven per cent and forty-one per cent respectively, but even these are striking evidence of the importance of the delta-fans, upon which are grown almost the entire rice crop as well as other crops which may belong to them somewhat less exclusively.

In major lineaments of site and culture the delta-fans are essentially similar, differing only in their details. They are all, to the human eye at least, essentially flat, and almost without exception devoted to the culture of irrigated rice, although not to the entire exclusion of other crops. Man has here taken advantage of the relative ease with which the lands can be flooded by means of gravity irrigation systems from rivers flowing at, or even slightly above the surface of the plains, to develop a food crop, high in its yield per unit area, having excellent keeping qualities, and which requires inundation for its best growth. As is the case in most regions under a monsoon regime, Shizuoka gets the major part of its precipitation during the warm season, nearly sixty per cent of the total 79 or 80 inches falling from May to September inclusive, which materially supplements the artificial supply and assures of the rivers having an abundant flow at the time when they are being heavily tapped for irrigation purposes. Multitudes of diminutive fields, averaging perhaps one-tenth to one-eighth of an acre in size, irregular in outline, and each enclosed by tiny dikes ten to fifteen inches wide and of equal elevation, form a landscape which is a faceted mosaic in pattern but with rather uniform colorings. At certain locations on some of the plains one can gaze for a mile or more over expanses of paddy fields where there is not a single variation to mar the monotony, but this is the exception rather than the rule. Interruptions may be in the form of villages, frequently tree or hedge enclosed, which rise like islands above the inundated paddies; elevated roads and footpaths traverse the plains usually in straight line courses; intersecting irrigation and drainage canals add a note of variation here and there, while in places isolated and scattered dry fields, elevated two feet or more above the paddies and bearing crops of vegetables, winter grains or other unirrigated crops, ". . . stand out above the bright green rice plain as the isolated flower beds in our gardens rise above the well-kept turf." On the dikes of the paddy fields are sometimes planted a few dwarf bean plants.

The march of the seasons ushers in a succession of landscapes on these delta plains such as the uplands do not experience. April witnesses the preparation and sowing of the rice seed beds which by May make themselves conspicuous as they stand out in bright green patches on the prevailingly fallow plains. In June with the transplanting of the young rice seedlings to the paddies, the flooded alluvial lowlands become a much subdivided water surface (Fig. 40). By midsummer the scene has changed and green is the prevailing color over large expanses of rice land, the individual plots still being obvious, however, as they are set off from one another by interruptions at the unplanted dikes (Fig. 41). As the green changes to yellow in late October and November and the ripened grain is harvested, the fields swarm with human beings engaged in

FIG. 40—Recently planted paddies. Note young plants projecting up through the water in the inundated fields.

cutting and threshing their precious crop for delay may mean serious losses through damage by wind and flood, for autumn is the season of typhoons. After harvest the plains look shorn and desolate, the only evidence of the recent crop being the bundles of rice straw or unthreshed grain hung on horizontal poles, set up in the stubble-covered, swampy paddies (Fig. 42).

FIG. 41—A portion of the Abe Plain in late August when the rice has attained its full height. The dikes now appear as interruptions.

Probably seventy per cent of the paddy area of Shizuoka remains fallow during the winter season,[54] much of it covered with water and becoming the home for myriads of frogs and other amphibious animals. This reflects, in part, the inability to adequately drain large areas of the delta-fans so that they will be suitable for winter grains, and, in part also, the desire to allow these none-too-fertile soils a rest from constant cropping. Genge, a leguminous forage crop with bright pink blossoms, is sometimes sown broadcast among the uncut grain or among the stubble in the

[54]Out of a total of 61,500 cho (1 cho = 2½ acres) in paddies about 13,000 cho are planted to winter grains and rape (6820 cho in barley, 3682 in rye, 2261 in wheat and 281 in rape). Nearly 3500 cho are sown to genge, a green manure, but a portion of this belongs to the uplands. Data from *The Annual Census of Shizuoka Prefecture,* 1925 (In Japanese).

FIG. 42—A fallow section of the Abe Plain in the winter season.

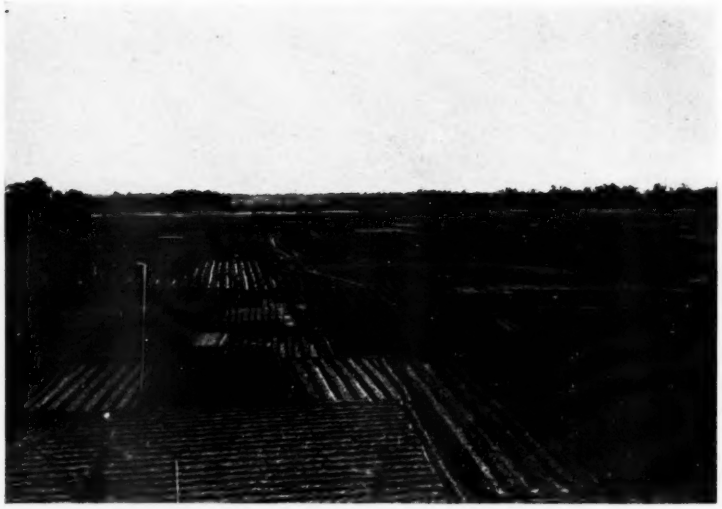

FIG. 43—A section of an alluvial plain in which many of the paddies are planted in winter crops. Note that water stands in some of the troughs between the ridges.

partially drained paddies. A portion of it may be cut for forage purposes but it is usually spaded under as green manure. If the fields are to be planted to grains, chiefly barley, rye and wheat, or to rape, the surface is spaded up into a series of narrow parallel ridges and troughs, the former a foot to eighteen inches wide, and on the ridges grain is sown very thickly in single or double rows. The practice of "ridging" for winter crops is quite essential, for winter precipitation tends to keep the paddies very wet. It is not uncommon to see water several inches deep standing in the troughs between the rows of grain or rape (Fig. 43). The cropped sections of the delta-plains are never more gorgeous than in the late spring when the dark green patches of winter grains in rows are to be seen intermingled with squares of brilliant yellow rape and bright pink genge. J. J. Rein offers the following description of the kaleidoscopic landscapes of a Japanese delta-plain: "In the spring of 1875 I had occasion to traverse at different times, the plain of Ozaka, which is watered by the Yodogawa, the outlet of the Biwa Lake. On April 1 the first rape-blossoms were visible. Barley and wheat had not yet put forth their stalks. There were but few fallow rice-fields to be seen. On June 3, scarcely nine weeks later, as I again traveled the same road, rape and barley harvest had commenced, and wheat was quickly nearing maturity. Once more on June 26, three weeks later, I had an opportunity of seeing this fruitful plain and rejoicing on its fine cultivation. What a change had taken place in that short time! Of the winter crops—rape-seed, barley, wheat, peas, broad beans—of the high beds and deep furrows in the dry fields, of the countless happy mortals who were busy with the harvest on June 3—of all these there is now nothing to be seen. The whole wide plain appears as if transformed by magic. Great reaches of it have been levelled, girt about by dikes and ditches and changed into a marsh. The muddy ground is covered everywhere with rice-plants of a lovely green, out of which, here and there, dry patches with other crops project singly. Now and then one sees a solitary farmer stalking through his field of rice, here regulating the ingress of water with his hoe, there pressing in a plant more firmly with his hands or replacing those that have not sprouted. Silver-herons fish in this artificial swamp between the green rows of rice-bunches, and men fish in the intersecting ditches. Yet a few weeks, and one looks out over a continuous carpet of the loveliest emerald green, like a cultivated lawn, in which also, there is no lack of

flower-beds, in the form of small dry patches bearing cotton, millet and vegetables."[55]

a. *The Fuji-Kiise Plain*

The alluvial plains along the seaward margins of Fuji and Ashitaka Mountains are composed of the delta-fans of the Fuji and Kiise rivers on the eastern and western margins respectively, together with a long narrow connecting plain which is a filled lagoon with a barrier beach on its ocean-side. This trough-shaped plain lying between the volcanic uplands and the barrier beach is semiamphibious in nature, a swamp nearly two miles long and over half a mile wide, grown high with tall rank grasses, still occupying its lowest part. The two deltas, one at either end of this soggy plain, are more elevated, with a perceptible slope toward the sea and the beach ridge is absent, so consequently they are better drained. These drainage contrasts are particularly obvious during the winter and early spring, for at these seasons the paddies of the two deltas are green with sprouted wheat and barley while those of the filled lagoon, frequently under water, are largely fallow. The delta-fans of the Fuji and Kiise rivers, together with the valleys of these same two streams upmountain from the deltas, where hydroelectric power is abundant, have the distinction of being one of the three principal foci of manufacturing industries in Shizuoka Prefecture.[56]

Irrigated paddies occupy the larger part of the alluvium plains. The delta-fans are particularly easy to irrigate because of the gentle slopes away from the river channels which occupy their crests. The filled lagoon receives its waters from mountain-fed springs and creeks which descend into its basin and combine to form a sluggish parent stream which flows along the trough, parallel with the coast, spreading out into a swamp in one section, then narrowing again to stream-like proportions before it breaks through the barrier beach to the sea. In years of drought bumper crops are the rule on the filled lagoon where ground water is so near the surface, but in wet years these same fields are almost untillable because of the excess of water. Farmers here speak of their paddies as "floating" and during rice transplanting the

[55]J. J. Rein, *Industries of Japan, Together with an Account of Its Agriculture, Forestry, Arts, and Commerce.* New York 1889, p. 44.

[56]The description and interpretation of this phase of the cultural landscape has been elaborated upon in a previous section of the paper—See pp. 165 and 170.

workers have been known to sink to their hips in mire. Villages are absent and roads scarcely exist. A number of footpaths cross the wet plain allowing bicycle and pedestrian travel between the villages at the base of Ashitaka and those on the barrier beach but only one highway suitable for vehicles crosses the lagoon-plain throughout its entire length of fifteen miles or more. The somewhat greater elevation, steeper gradients and more gravelly soils of the delta-fans have resulted in a less monotonous culture than is true of the filled lagoon where rice is the exclusive crop. In the Kiise Delta both vegetable and mulberry patches are numerous although they are minor as compared with rice. Villages are not infrequent and Numadzu, a semi-industrial city of nearly 40,000 inhabitants, is located along the river not far back from the coast. The Fuji Delta-Fan, with its numerous widely scattered villages and network of roads, together with its mixed culture of pear orchards and paddies, offers even more of a contrast to the lagoon-plain. The river and its distributaries flow in a broad bowlder-strewn channel, diked on either side, which widens toward the sea until at the coast it is fully two miles in breadth. The railway which has been closely paralleling the coast up to this point is compelled to swing inland three or four miles in order to avoid crossing the broader lower channel, but even up-stream at the point where it does span the river, a long bridge, fully one-half mile in length, has been necessary.

The sandy and gravelly alluvium on either side of the river, but more particularly that portion south of the railroad on the eastern side of the stream, is the most extensive and specialized area of Japanese pears in the country. Rice is by no means lacking, paddies perhaps occupying the larger part of the whole delta, but there are areas where pear orchards dominate the landscape. The trees are diminutive in height, shallow-rooted, and their fruit-bearing branches are always supported on horizontal trellises (Fig. 44). This precaution is necessary to guard against tree breakage and fruit damage in the late summer when the fruit is large and heavy and the strong typhoon gales most frequent. Pear trees, being shallow rooted and at the same time requiring large amounts of water, especially during the fruit-maturing season, are forced to compete with rice for locations in the low alluvial lands where the sub-soils are constantly damp and where irrigation water can be supplied at proper intervals. Light and porous top-soils are desirable, however, for pear trees will not tolerate saturated soil conditions as will rice. The near optimum in site

FIG. 44—An orchard of native pears surrounded by fields of rice.

conditions seems to be provided in the porous soils of the Fuji Delta-Fan, adjacent to the relatively quiet and protected waters of Suruga Bay, where damage from destructive winds is at a minimum.

Bounding the wet lagoon-plain on its ocean side and extending from the Kiise to the Fuji Deltas is a single long barrier beach, asymmetrical in cross section with its steeper slope toward the sea, varying from thirty to sixty feet in elevation and averaging one-half mile in width (See Fig. 15). The seaward slope of the now land-tied bar is composed of wave-washed sands and gravels utilized only by the fishermen who beach their boats and dry their nets and their fish upon its outer margins. The crest of the barrier beach is planted in a thick wall of conifers owned and protected by the state and serving to break the strength of winds from off Suruga Bay and to anchor the loose migrating sand. Along the inner or landward slopes of the beach and thus behind the windbreak, is a long, thin, and almost continuous line of village whose main and only street is the national trunk highway of the Pacific coast of Japan, which in turn is closely paralleled and crossed at several points by the Tokkaido Railway, the principal artery of commerce in Nippon. Villages and traffic routes alike

have obviously selected the regular and elevated surface of the beach as a superior location. (See Fig. 15.)

Lacking in running water for irrigation, and composed of warm well drained loamy sands and gravels, the barrier beach has been developed into a region of commercial unirrigated agriculture with a three-fold crop specialization, namely; peach orchards, summer vegetables and mulberry, all of them crops with a high degree of tolerance for sandy soils. In 1925 there were 45,000 peach trees of bearing age on this sandy bar and their harvest amounted to 1,300,000 pounds of fruit.[57] This tree crop occupies the most sheltered locations available, on the immediate landward side of the coniferous windbreak and between it and the line of

FIG. 45—A portion of the old barrier beach which fringes the coast south of Fuji and Ashitaka. This view, taken from the landward side, shows the protective line of conifers along the crest of the ridge with peach orchards between it and the village.

village (Fig. 45). It can scarcely be said that peach trees are extremely sensitive to soil conditions, but they are partial to deep, well-drained soils, and such an environment is perfectly provided in the sandy beach loams. The crop is marketed principally in the large urban centers which lie not more than 150 miles distant,

[57] *Annual Census for Shizuoka Prefecture,* 1925 (In Japanese) p. 28.

both to the north (Tokyo and Yokohama) and south (Nagoya, Kyoto, Osaka and Kobe), along the Tokkaido Railway. During the summer season the energy of the farmers is largely expended upon vegetable crops, including melons, cucumbers, egg-plant, sweet potatoes and daikon, which find the soil environment even more than satisfactory, if not quite the optimum, for although it is dark-colored, warm, and light in texture, it has sufficient body to prevent it from being extremely arid. Artificial watering is therefore not required. Following a two-crop or three-crop rotation of vegetables during the long warm summer, these same fields are sown to winter grains so that the green of growing crops is never absent from the landscape.

Between the Fuji Delta-Fan and the Abe-Tomoe Plain the sedimentary rock mountains so closely approach the sea that coastal plain is for the most part lacking. Two small streams, perhaps creeks, reach the sea along this stretch of coast, carrying two limited enclaves of paddy-floored alluvium back into the mountain mass. The Tokkaido Railway, in order to negotiate this section of the coast is forced to tunnel the mountains for some length at one place, while in longer stretches the roadbed is so near the water's edge that high cement sea walls have been constructed to protect it from wave erosion. Where the intervening strip of beach between the mountains and the sea is a trifle wider, small villages exist, their citizens wresting a livelihood from the sterile beach sands by the cultivation of vegetable and grain crops for food; from the overshadowing mountain slopes where the orange and tea crops are specialized forms of culture; and from the waters of Suruga Bay whose resources are exploited to a maximum degree. Necessity apparently has directed the trend of specialization so that Ambara Gun, by a wide margin, holds the premier position in the production of mandarin oranges and is second only to Shida Gun in the value of its marine products, which in 1925 exceeded 4,000,000 yen. The villages of Yui and Kamohara are both famous as lobster fishing centers while the canning and drying of marine products is a specialized industry, the tinned products in 1925 being valued at more than 2,000,000 yen or about one-half of the total value of the sea products within the gun. Much activity is in evidence along the coastal margins of Ambara Gun, reflecting the importance of the marine industries. Numerous small boats dot the adjacent waters of the bay; scores of others are drawn up along the outer beach, while the drying and repairing of nets is carried on in the same location.

Okitsu, near the southern and eastern end of this coastal strip, has acquired some fame as a resort and sanitarium city. Many sickly people, especially those with symptoms of tuberculosis, inhabit this warm and protected spot during the winter season to bask in its sunshine and warmth and to enjoy the magnificent view of Suruga Bay. Others come seeking pleasure as well as health, both during the winter and the summer. Cottages have been built along the beach, some owned by those who inhabit them at various times of the year, although there are those which can be rented. Several well-appointed seaside inns likewise cater to the transient resort trade. Additional prestige and fame also accrue to Okitsu through the location of the National Horticultural Experiment Station, with its experimental farms, on the outskirts of the city.

b. *The Abe-Tomoe Plain (Including Miho Spit).*

The combined delta-fans of the Abe and Tomoe rivers are another of the small discontinuous alluvial patches devoted to rice culture, which fringe the perimeter of Shizuoka. On its landward sides it is walled in by the mountain province, spurs from that region reaching to the immediate ocean margin so that the Tokkaido Railway has ingress and egress to and from the Abe Plain only by means of tunnels. Kuno Mountain, a remnant of uplifted terrace, previously described, rises high above the alluvium on the southeast margins of the plain, being joined to the mainland by the river deposits which have partially surrounded it, the Tomoe River flowing eastward into Miho Bay along the depression between Kuno and the sedimentary-rock mountains. A very narrow strip of alluvium, with a series of parallel beach ridges, bearing villages on their crests, borders Kuno on the east, and merges on the south into the compound recurved spit of Miho whose sandy surface is a specialized vegetable garden. A similar line of elevated beach borders the outer margin of the larger plain where it fronts on Suruga Bay.

The junction of the alluvial plain with the surrounding mountain foothills is abrupt as well as irregular for here there are no intervening terrace uplands between the two. The zone of contact is one of irregular, ragged dovetailing, the southward projecting spurs of mountain, where intermingled patches of tea, orange groves and woodland prevail, separated from each other by deep enclaves of alluvial paddy lands where villages are numerous. One extremely long sliver of mountain, known as Shizuhata, and said to be a volcanic dike, thrusts itself southward almost into the heart of

Shizuoka City so that that urban center has apparently flowed around its seaward end and enveloped it. On its crest a tiny park has been established, provided with benches and tea houses where one may sit and enjoy the panorama of mountains, plains and ocean spread out before him. Adjacent to the capital city, two mountain outliers, Tanitzuyama and Hachimanyama, outliers both physically and culturally, rise like islands above the flood of alluvium which has engulfed them (Fig. 46).

FIG. 46—The steep slopes of Hachimanyama, a small outlier of the mountain province in the Abe Plain, almost completely planted in tea gardens. Note the abrupt change in culture where the slopes make contact with the alluvium. A large cotton spinning mill is located at the base of the outlier.

The general physical and cultural forms on the Abe Delta-Fan are not greatly unlike those of alluvial plains in general in Japan. The customary irregular grid of paddy fields dominates the entire scene with here and there elevated patches of unirrigated crops and a still greater prevalence of pear orchards of the native variety. The concentration of this orchard crop is on the plain south of Shizuoka City and more especially that portion west of the Abe River where in places orchards are the exclusive culture over several acres. The Abe Plain supports 98,000 pear trees of bearing age which produce an annual fruit crop valued at $95,000.[58]

[58] *Annual Census for Shizuoka Prefecture,* 1925 (In Japanese), p. 29.

The soils of the delta-fan are prevailingly loamy clays with porous subsoils, which can scarcely be called an ideal combination for rice, for when the fields are inundated the heavy soils become sticky and difficult to work. This is not a deterrent to rice culture, however, even though it is an inconvenience, for, except on extremely sandy soils, any level surface where water is easily available is likely to be planted in paddy. To the unpracticed eye at least, variations in soil and drainage conditions on the plain are not sufficiently marked to have a visible effect upon the kind and quality of the growing crops although they do have an appreciable effect upon yields per unit of area and upon land values. In an interview with the mayor of Toyota Village and his associates concerning land values in their village, which includes a portion of the western flanks of Kuno and a section of the Abe Plain between Kuno and Shizuoka City, they sketched on a map the several subdivisions of the village based upon assessed land values. The highest priced section, valued at approximately $1200 per acre, is that close to the city, whose irrigation water flows through the city and therefore contains much fertilizing material. A much larger part of the village's rice land, which is not benefiting from proximity to the city and its sewage-enriched waters, is valued at about $1000 per acre while smaller areas where drainage is poor and soils particularly heavy, with high humus content, are assessed at about $850 per acre. The strip of best upland tea land along the western flanks of Kuno has values ranging from $1200 to $1800 per acre, while the latter figure applies also to tea gardens on the mountain outlier, Tanitzuyama, where disadvantages of thin stony soils, with smaller yields of tea, are counterbalanced by very close proximity to the city of Shizuoka.

In parts of the Abe Plain one is struck by the more uniform and perfect rectangularity as well as the larger size of the paddies than is normally true for paddy landscape. Where this more regular culture-pattern prevails it is indicative of an adjustment of farm lands under government supervision by which arrangement a farmer is given the equivalent area in one contiguous plot to the combined areas of his previously scattered patches. By this process of adjustment a number of advantages are to be gained. (1) Owing to the increased size of the plots of land and the regularity of their shape, farm work is more easily expedited and farm animals and labor-saving machinery can more easily be utilized. (2) Owing to the farm boundaries or dikes being straightened, or those that are useless destroyed, the productive power of a given

area of land thus treated is increased on the average about five per cent.[59] (3) The reconstruction of the canal system allows both irrigation and drainage to be brought to a higher state of perfection than was previously the case. Through this improvement, which insures to a greater degree against deficiency or excess of water, the productive power of the farm is increased. Because of more efficient drainage, lands that prior to adjustment were too wet for winter crops, can often be made fit for unirrigated cool-season grains. It was suggested that by thus permitting a second crop it was possible to increase the unit-area production by fifteen per cent.

In Abe Gun, which includes most of the Abe Plain, out of 5000 cho[60] of wet fields or paddy, only 930 cho, or seventeen per cent of the area, is replanted to winter grains. Small amounts of rape and genge are also grown but in all probability the grand total would not much exceed twenty per cent. This relatively small proportion of the land which is made to yield a second crop reflects in part the poorly drained nature of large areas on the delta, its paddies remaining flooded throughout much of the winter. A further suggestion is that the relatively high degree of specialization in commercial crops on the adjacent mountain slopes and on Kuno has led to the omission of winter crops on the plains. Some genge and potatoes are planted in the spring but owing to the cold wet soil the tubers are small and soggy and foreigners consider them unfit for eating.

A modification of the general landscapes of the plain as they have been previously described, is found along its seaward margins where winds and waves have produced low beach ridges whose crests average fifteen to twenty feet in elevation. Strong longshore currents parallel this coast so that the small streams entering the bay are turned eastward and flow parallel with the littoral for a mile or two before finally debouching. Coniferous trees most frequently cap the crests of the beach ridges, serving both as a windbreak and to anchor the shifting sand. The landward slopes are the sites for villages and for an intensive upland agriculture in which plots of mulberry, tea, vegetables, and peach orchards are intermingled. A series of two, and sometimes three, low beach ridges parallel the coast of Miho Bay in the narrow alluvial plain east of Kuno Mountain. Long lines of village together with

[59] *Japan at the Beginning of the 20th Century*, op. cit., p. 101.

[60] One cho =2.45 acres.

plots of the usual upland crops occupy these higher and drier sites, separated from each other by the broad lower troughs of intervening paddy. The city of Shimizu, which is the port of Shizuoka, and the third largest city of the prefecture, occupies, in part at least, beach ridge sites.

The Abe River, which is the master stream of the delta-plain, is not navigable. It flows in a broad bowlder-strewn channel three-quarters of a mile wide, shallow and very much braided at most times, but becoming a swollen torrent after heavy rains. As is quite normal for alluvial fans, the river flows at a level slightly higher than the general level of the plain, which increases the danger from flood. To prevent such catastrophes dikes ten feet or more in elevation have been erected parallel to the river; in certain stretches there is a system of double dikes. The embankments are sometimes sufficiently wide to carry roads on their crests but more frequently they are only foot and bicycle paths. Where the dikes are double, the one hundred yards or so of sandy, gravelly plain between them is much less exclusively devoted to paddy than elsewhere in the delta and unirrigated crops of tea, pears, mulberry and vegetables prevail.

The primary value of the Abe River is the use made of its waters for irrigating the paddies of the delta-plain. Because of the slight elevation of its channel, a simple gravity system of irrigation is all that is necessary. Although the Abe is not navigable for boats it serves as a carrier for log rafts which are floated down from the mountain province and collected at mill villages along its banks. In places artificial lagoons are excavated in the plain adjacent to the stream where the logs can be collected and stored until it is convenient to saw them. Activity is not entirely absent from the immediate stream bed, for wagons and carts, and men with screens or seives are usually to be seen on some of the inter-channel sands and gravels, gathering these materials which are used in abundance in road construction, concrete structures, and other works.

Rural villages, ". . . sad grey hamlets roofed in grey thatch . . .," abundantly dot the surface of the Abe Delta-Fan while two relatively large cities, Shizuoka, the prefectural capital, and Shimizu, the port, with populations of 84,000 and 46,000 respectively, are foci of commerce and industry, serving not only the immediate plain, but territory beyond as well. A relatively large number of the villages seem to possess no advantages of site but are haphazardly set down in the midst of paddy fields. Some tend to cluster

along the beach ridges adjacent to the coast where drainage is superior and where the exploitation of the sea resources is possible. Others have sought sites adjacent to, or even on the extreme lower slopes of Kuno and the sedimentary-rock mountains for in such locations both paddy and upland farms are most easily accessible. In a number of localities the villages follow with perfect regularity the oscillation of the lowest contour line of the mountain spurs. The main highways in Japan are almost invariably paralleled by slender elongated villages, sometimes continuous for miles. "In the smaller villages the houses are stretched along the sides of a single road, nearly all being arranged in this way, sometimes extending for a mile or more. Rarely ever does one see a cross street or lane, or evidences of compactness, save that near the center of this long street the houses and shops often abut while those at the end of the streets have ample space between them. . . . It is a curious fact that one may ride long distances in the country without passing a single dwelling and then abruptly enter a village. . . . Having passed through the village one enters the country again, with its rice fields and cultivated tracts, as abruptly as he had left it. The villages vary greatly in their appearance; some are extremely trim and pretty, with neat flower plots in front of the houses, and an air of taste and comfort everywhere apparent; other villages present marked evidences of poverty, squalid houses with dirty children swarming about them. . . . It is difficult to imagine a more dreary, dismal sight than the appearance of some of these village streets on a rainy night. No brightly-lighted window cheers the traveller; only dim lines of light glimmer through the chinks of the wooden shutters with which every home is closed at night."[61] The heavy, steeply-pitched tile or thatch roofs, the thatch sometimes two feet or more in thickness, project in wide eaves well beyond the walls of the dwellings, carrying the heavy run-off well away from the house walls. The roofs ofttimes appear too heavy for the flimsy frame and mud-plaster structures which support them. The external walls, if of wood, are usually unpainted, and if of plaster they are either the color of the soil from which they are made or sometimes they are whitewashed. Being unpainted, they suggest poverty and to an American, accustomed as he is to the bright contrasts of painted houses, with their pretentious porches, warm red chimneys and their general trimness, and the

[61]Edward S. Morse, *Japanese Homes and Their Surroundings,* New York, 1904, pp. 4-5.

whole surrounded by well-kept lawns and shade trees, the Japanese dwellings, singly and collectively, seem barren and uninviting.

Shizuoka, the metropolis of the Abe-Plain, is advantageously located on a slightly higher swell of alluvium, two bench marks within the city registering 21.49 and 28.2 meters, which is 5 to 15 meters above the average level of the plain. The hub and center of the city about which all the rest clusters is the moat encircled palace grounds, at one time the residence of a retired Shogun. The double system of moats, now nearly dry, with their splendid walls of beautifully fitted cut stone are still intact, but the inner palace grounds have been converted into a drill field with army barracks while various public buildings, together with a Roman Catholic school and church, occupy the outer grounds between the moats. Shizuoka is a relatively old city, renowned as one of the numerous hostel points along that famous century-old Tokkaido Highway between Kyoto, the old Imperial City, and Yedo (Tokyo), where the Tokugawa Shoguns held sway. Its modern needs are better served by the Tokkaido Railway, twenty-five passenger trains passing through the capital city in a day. An electric tram line supplements the service of the Tokkaido Railway between Shizuoka and the port of Shimizu, while a private narrow gauge steam railway, which parallels the Abe River for a short distance back into the mountains, links the capital city with that province.

In general features and lineaments Shizuoka has much in common with most Japanese cities. Morse stresses the following characteristics. "A birdseye view of a large city in Japan presents an appearance quite unlike that presented by any large assemblage of buildings at home. A view of Tokio, for example, from some elevated point reveals a vast sea of roofs, the gray of the shingles and the dark slate color of the tiles with dull reflections from their surfaces, giving a sombre appearance, form, with the exception of the temples, one of the most conspicuous features in the general monotony. The temples are indeed conspicuous as they tower far above the pigmy dwellings which surround them. . . . Green masses of tree foliage springing from the numerous gardens add some life to this gray sea of domiciles. It is a curious sight to look over a vast city of nearly a million inhabitants, and detect no chimney with its home-like streak of blue smoke. There is of course no church spire with its usual architectural inanities. With the absence of chimneys and the almost universal use of charcoal for heating purposes the cities have an atmosphere of remarkable clearness and purity; so clear, indeed, is the atmosphere that one

may look over the city and see distinctly revealed the minuter details of the landscape beyond. The great obscuring canopy of smoke and fumes that forever shrouds some of our great cities is a feature happily unknown in Japan."[62]

The refiring, blending, packing and export of tea for foreign consumption is centered in Shizuoka and is that city's chief claim to fame. It is estimated by the tea men of the city that probably one-half of all the refiring plants in the prefecture are in Shizuoka and all of the large exporting firms have their main establishments there. Some of the foreign buyers remain in Japan all the year round but many keep residence in Shizuoka only during the tea season, i.e., from May to September inclusive, returning to America during the off-season. In the western part of the city, most adjacent to the Abe River, which brings the logs from the mountains, there is a concentration of small saw mills and box factories. Standing on top of Shizuhata, overlooking Shizuoka, one can see this concentration of mills with their small lumber piles adjacent, and hear the hum and screech of the numerous circular saws.

The port of Shimizu has a superbly protected natural harbor, an indentation of the relatively quiet waters of Suruga Bay and almost landlocked behind the compound recurved spit of Miho. The city itself and its suburbs are located upon a triple series of parallel beach ridges. Shimizu is an ocean port engaged in both foreign and domestic commerce, but the harbor is not sufficiently deep nor provided with adequate port equipment to allow ships to come up to the dock to load and discharge cargo, consequently they anchor in the bay and load and unload by means of lighters. The port is served by the Tokkaido Railway whose spur lines approach close to the water front, thereby expediting the transfer of freight to and from the boats.

An analysis of the customs figures for Shimizu indicates that its foreign trade is one-third as large again as its domestic trade. Tea is the single outstanding item of foreign export representing over seventy-five per cent of the total, and reflecting the specialization of the hinterland in tea growing, and the concentration of tea-processing and export houses at Shizuoka, not more than ten miles distant. Shimizu is the one great tea port of Japan, handling over ninety-five per cent of the total foreign export of that product. Large transpacific steamers, American, Canadian, and Japanese,

[62]Morse, op. cit., pp. 1-2.

make Shimizu a port of call during the tea season from May to September, and again in November and early December four or five of these same large liners tarry at Shimizu to collect the cargo

TABLE I. TRADE OF THE PORT OF SHIMIZU, 1926.[63]

I. FOREIGN TRADE

1. *Exports.*

		Piculs	*Yen*
1.	Tea	160,052	11,036,405
2.	Oranges	31,475	510,900
3.	Bean oil	132,602	2,729,783
4.	Mushrooms	193	50,247
5.	Shoyu (bean sauce)	.....	20,083
6.	Bonito (fish)	.....	16,419
7.	Lacquer wares	.....	14,223
8.	Paper	.....	8,166
9.	All others	.....	12,731
	Total	.....	14,398,957

2. *Imports*

		Piculs	*Yen*
1.	Rice	12,646	123,228
2.	Kaoliang	4,831	21,908
3.	Beans	2,087,442	14,185,490
4.	Small beans	33,539	188,878
5.	Salt	88,412	91,261
6.	Coal	88,650 tons	1,141,177
7.	Cement	1,714,230	35,731
8.	Tin foil	1,524	49,046
9.	Lumber or logs	48,459	1,084,993
10.	Wheat bran	199,049	912,758
11.	Bean cake	583,762	2,945,767
12.	All others	.....	195,844
	Total	.....	20,986,081

II. DOMESTIC TRADE.

1. *Exports:*

		Piculs	*Yen*
1.	Lumber	86,887 koku	521,332
2.	Oranges	66,170 boxes	122,310
3.	All others	.....	42,812
	Total	.....	886,454

[63]Data obtained from Customs House at Shimizu.

2. *Imports*:

		Piculs	*Yen*
1.	Lumber	1,809,370 koku	11,293,572
2.	Coal	315,585 tons	5,458,542
3.	Rice:		
	cleaned	178,329 bags	2,781,313
	uncleaned	168,154 bags	2,271,282
4.	Cement	.....	508,750
5.	Salt	.....	1,071,129
6.	All others	.....	1,178,200
	Total	.....	24,562,788

of oranges, which fruit is third in rank by value among items in the foreign export list. At other times of the year they pass it by. The large export of bean oil is not an indigenous industry based upon a home grown crop but depends rather upon beans imported from Manchuria, this one item representing over two-thirds of the value of the total Shimizu foreign imports. A large factory for expressing oil from beans is located in the port city, its immense oil storage tanks and high smokestacks standing out quite in contrast to the general nonindustrial character of the city. A $1,500,000 import of bean cake, likewise from Manchuria, bears testimony to the use of that by-product in enormous quantities to sustain an intensive agriculture on soils of relatively

FIG. 47—Sawmill along the inner coast of Miho Spit.

low fertility. Coal from Manchuria enters through the port of Shimizu in small quantities, the large coal piles along the water front giving material evidence of this item of the trade.

As a port for domestic commerce Shimizu is almost exclusively an import center, lumber in the form of logs from Hokkaido and Sakhalin composing forty-six per cent of the total value of that trade. One of the common sights in Miho Bay is the great rafts of floating logs and the boats lying offshore a mile or more dumping their cargoes of logs into the sea. Coincident with this sight are the large piles of logs and lumber around the numerous saw mills which dot the coast of Miho Bay. Lumber manufacture is a specialized industry in this vicinity, as many as seventy saw mills having located along the water front [64] (Fig. 47). The advantage to be gained from being able to deposit and temporarily rest the logs in these quiet waters, the comparative cheap land along the coast for mill and log storage sites, and the abundance of cheap local hydroelectric power, have been items attracting location.

Mihomatsubara.—The triple curved spit of Miho, washed by the waters of the warm Kuro Siwa, endowed with dark, warm, sandy soils, and adjacent to rapid transit furnished by the Tokkaido Railway, has been converted into a specialized truck gardening center. This is, however, a development of the past few decades since Miho, thru fast rail service, has been brought close enough to the great consuming centers so that the maximum use could be made of the infertile, coarse-textured soils. The earlier culture stratum on Miho was one which was concerned with the exploitation of the resources of the sea, for the gathering of seaweed and the catching and drying of fish occupied the time and attention of the villagers. And in spite of the new culture superposition, which has in a large measure superseded the old, remnants of the latter still persist. The sight and odor of drying fish are prevalent in the villages, and in the shallow waters just off-shore in Miho Bay there are acres of water surface where branches and saplings have been stuck down into the mud to catch the kelp as it is floated in and out on the tide movements. Saw mills dot the inner coast of Miho, their piles of logs and lumber being conspicuous items of landscape, while a small establishment for the building of small wooden fishing boats, parasitic to both the lumber and fishing industries, has chosen a similar location. The sale price of land on Miho is not determined any longer by its agricultural productivity but rather it is related

[64] From interview with manager of one of the mills.

to its potential value for industrial sites as Shimizu expands. The beginnings of this hoped-for expansion are already to be seen in the saw mills and the boat factory.

At the present time, however, Miho is almost exclusively a great vegetable garden, growing crops practically all year round but nevertheless specializing in early season products. The side of the spit bordering on the open waters of Suruga Bay has a wide sand beach terminating on the landward side in a sand ridge capped with conifers, the latter feature acting both as a wind break and sand break. No such sand beach exists on the inner coast of the spit and vegetable gardens and villages extend almost out to the water's edge. The soils are apparently almost pure sand and gravel, so that upon picking is up it readily runs out between the fingers. Its dark color is no doubt due to the humus which it has collected, but in spite of that admixture it is sterile and infertile and almost unbelievable quantities of fertilizer are necessary to correct this deficiency. Its dark color and coarse texture, however, cause it to be warm, dry, and easily tilled and these are significant items in the production of vegetables for the early spring market. A plus temperature anomaly characterizes this water-enveloped strip of land in the cool season, thereby expanding the growing season for sensitive vegetable crops. The whole physical and cultural set-up of the region closely parallels the situation found in the specialized truck gardening regions of the much indented North Atlantic Coastal Plain of the United States.

The summer fields are devoted to a considerable variety of vegetable crops, such as sweet potatoes, onions, cucumbers, egg-plant, daikon, and others which are more minor. The droughty soil makes frequent watering necessary so that shallow wells 15 to 20 feet deep are numerous on the sandy plain, the tall sweeps by which water is raised from the wells being very prominent landscape features. Here, as on the sandy strip south of Kuno, cucumbers grown under frames during the winter and early spring are a specialized crop. A still more expensive development is the sprouting and growing of vegetables in greenhouses although this practice is not done on a large scale. Many of the vegetable plots are planted in winter grains during the cool season, more especially in barley, for it, better than wheat, is able to thrive in the droughty soils. In late April when the writer was on Miho vegetables had already been set out between the rows of grain.

Toward the northern or farther end of the spit quite a different combination of landscapes prevails. Here the vegetable areas are

like sandy-floored sunken gardens separated by irregular ridges ten to twelve feet high, capped with conifers (Fig. 48). Inquiry among the inhabitants concerning the origin of this peculiar labyrinth of flat-bottomed basins and dividing ridges did not yield entirely satisfactory results. One citizen insisted that the basins were at one time occupied by the sea, which might lead one to believe that they were old tidal channels. The common belief is, however, that man is at least partially responsible for the system of ridges and basins, although it was mentioned by some that there were original depressions which man had only improved upon by leveling the floors. The advantage of the arrangement, however, and for what purpose it was brought into existence, is that the floors of the basins are sufficiently near the water table so that the vegetables can be grown without irrigation. Wells and well sweeps are therefore absent from the landscape. The crop regime is also somewhat unlike that on the rest of the spit but whether this is related in any way to the site conditions the writer is not certain. A variety of sugar cane is a prominent crop in many of the basins, while a particular variety of early spring peas is a genuine specialization. The latter crop is planted during the winter, and harvest was in full swing when the writer was in this

FIG. 48—The sunken vegetable gardens with intervening tree-capped ridges at the far end of the Miho Spit.

section of Miho on April 20. In this particular variety the pods are flat and the seed peas are poorly developed so that the pods and peas together are cooked and served as greens. One other item of contrast is the lack of winter grains in the "bolsons," quite a large percentage of the vegetable plots remaining fallow during the winter season.

c. *The Oi Delta-Fan*

The Oi Plain is another of those small isolated enclaves of recent alluvium which are so characteristic of coastal Japan. Mountains or terrace lands hem it in on all sides except where it faces the sea so that the Tokkaido Railway gains access to the Oi Delta-Fan both from the east and the west only by means of relatively long tunnels. The Tokkaido Highway, likewise, passes the eastern barrier by a tunnel. In a multitude of ways the Oi Plain is essentially similar to the Abe Plain just previously described. It has similar surface features, monotonously level to the eye but with the contours swinging somewhat seaward as they approach the river which flows as a braided and unnavigable stream in a broad bowlder-strewn channel confined between man-constructed dikes, and they in turn protected by frequent wing dams. The Oi Plain is a more perfect fan with more regular slopes than the Abe Plain, which contrast is reflected in the better drainage on the former. Along the coastal margins low beach ridges duplicate those of the Abe Plain, having similar tree-capped summits, elongated fishing villages, and unirrigated crops, and with the minor streams which cross the beach ridge similarly turned in-bay by the long-shore current. The usual irregular grid of paddy fields monopolizes the plain.

In spite of these numerous duplications and similarities, the Oi Plain has a culture pattern which is distinctive and unlike those of the other delta-fans of Shizuoka. The common practice in rural Japan is for the yeomanry to gather together into distinct villages rather than living in isolated dwellings on their own small farms. Thus in spite of dense rural populations, relatively large expansive views on open plains are not uncommon. A sample of this usual type of rural landscape is to be found in the extreme northeastern part of the Oi Plain between Yaizu and Fujieda. But over much the larger part of the delta, compact villages do not exist and the numerous farm dwellings are scattered singly or in small clusters of less than half a dozen, rather evenly over the plain. Here apparently the farmers are living on their farms.

Hedges eight to ten feet high frequently enclose the dwellings, with trees planted within the enclosures and shading the house. Long lines of spindly trees border the canals, the rivers, the foot paths and even some of the dikes between the individual farms, so that the plain has a confused and cluttered appearance with a lack of extensive open spaces (Figs. 49 and 50).

FIG. 49—Landscape of the Oi Plain. Isolated dwellings or small groups of dwellings are the rule and trees are numerous so that the plain has a cluttered appearance. Winter grains occupy the paddies in the foreground.

Even after numerous inquiries among residents and village officials concerning the origin of this variation in delta landscapes, the writer is unable to formulate a thoroughly satisfactory explanation. It seems, however, in some way to be associated with the earlier wandering nature of the Oi River which prior to the time that it was confined between man-made dikes, which is relatively recent as Japanese history goes, ranged rather widely over its fan. Evidence is rather abundant to bear out this contention. In places the top soils contain a large amount of stone, in the form of smooth river gravels and in shallow cuts or pits found here and there over the plain one is able to see how relatively thin is the veneer of surface soil, usually underlain by a solid mass of grayish-blue river gravels such as one can now see only in the

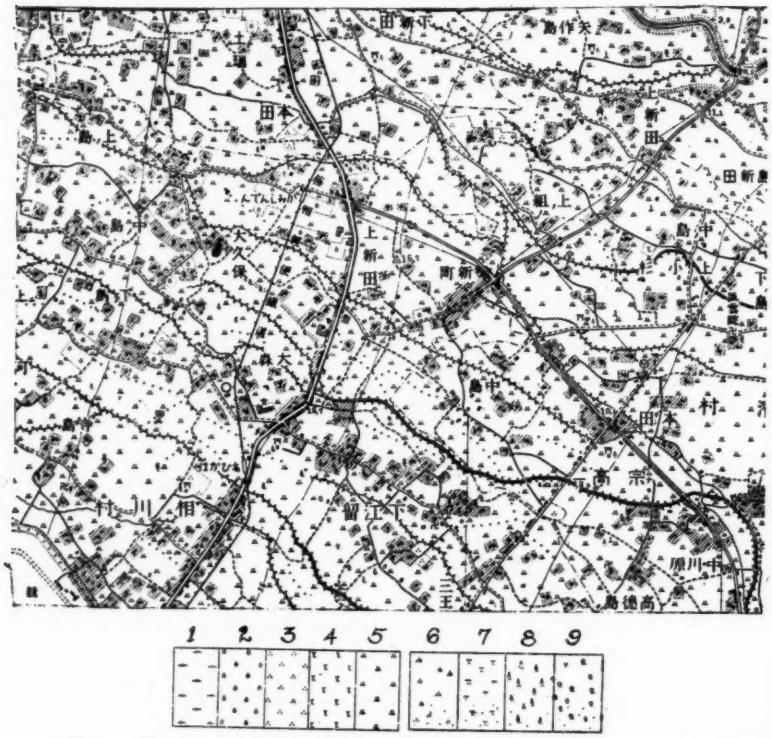

FIG. 50—A section of the topographic map (1/25000 Japanese Army Survey) of the Oi Plain. Note the general lack of compact villages and the prevalence of isolated dwellings. Contour interval 5 meters.

1. Grasslands.
2. Orchards.
3. Tea.
4. Mulberry.
5. Irrigated rice.
6. Wasteland.
7. Bamboo.
8. Coniferous trees.
9. Deciduous trees.

immediate river channels. In some places even the stony top soil has the ash gray or bluish coloring almost identical with that of the channel material. Soils vary greatly in depth and texture from place to place and while this is not reflected in kinds of crops it is quite obvious, so village officials say, in the matter of crop yields and land values. The mayor of Hatsukura village, which lies to the south and west of the Oi River, with the aid of his associates, outlined for the writer on the topographic map, the

various subdivisions of the lands within his village based upon land values. Class A, paddy land, having a deep sandy loam soil and producing 230 sho of rice per tan, was valued at 700 yen per tan.[65] Class B paddy land with a heavier loam soil with considerable humus, which because of its sticky nature when wet, gave yields of only 200 sho per tan, was valued at 600 yen per tan. The C lands, having light sandy soils, commonly produced only 180 sho per tan and were valued at 550 yen per tan. Here and there are to be observed faint relics of old stream channels and other erosional features not yet entirely obliterated after a long period of cultivation. The feeling seems to be rather prevalent, therefore, that the more evenly dispersed population of the Oi Plain is in some way associated with the comparatively recent reclamation and development of these lands for agricultural purposes and that this retarded utilization was related to inhospitable site characteristics in the form of stony infertile soils and the dangers asso-

FIG. 51—A diked stream in one of the valleys tributary to the Oi Plain. In the foreground the river is swinging close to the mountain so that only one dike is visible. Note that a road follows its crest with numerous dwellings along its flank. Bamboo trees are planted along the inner face of the dike, their thick root-systems tending to anchor the soil against active erosion by the river.

[65] 1 tan = .245 acre; 1 sho = 1/20 bushel.

ciated with a vagrant river. Circumstantial evidence gives some credence to this contention for in the northern part of the plain farthest from the Oi River, and again on the elevated beach ridges along the coast, population is collected into distinct clusters or villages. The mayor of Hatsukura village was of the opinion that the larger contiguous plots of land obtained by the settlers on these somewhat newer lands may have been a factor inducing them to build their homes on their own farms rather than in villages. From another source the suggestion came that the lack, or at least scarcity, of roads on the Oi Plain in the period before the river was diked may have been a decentralizing influence as regards the location of houses. To-day there is a growing tendency toward a very definite grouping of residences along the highways. Still another resident held the opinion that in the pre-dike days when the plain had presumably many minor irregularities, the farmers selected the scattered minor eminences as locations for their dwellings or in some cases selected sites adjacent to small and scattered areas of superior soils. It must be admitted that none of these suggestions offer an entirely complete and acceptable solution to the problem but since there may be an element of truth in some or all of them, they are here presented for what they are worth.

Rice is overwhelmingly the chief interest of the farmers and only in the northeastern part of the plain, or that section lying between Fujieda and Yaizu, does another crop, native pears, offer any competition. Next to the Fuji Delta this is the most specialized area in pear orchards anywhere in the prefecture. The orchards seem to be specially concentrated adjacent to the small streams which drain the area, where the soils are more porous and the land somewhat higher and better drained. Danger through loss of fruit by theft often leads to a centering of the orchards close to villages. This northeastern part of the Oi Plain therefore stands out in contrast to the rest of the delta in a number of ways: its village life as compared with prevailing custom of scattered residences, as previously pointed out; its large areas of adjusted paddies where neat and regular oblongs take the place of the usual variety of shapes and sizes; its somewhat heavier and more fertile soils with less gravel; its specialization in native pears, and the general lack of winter crops. In spite of the adjustment of fields that has taken place drainage has apparently not been sufficiently perfected to allow fall-sown grains to prosper.

The Oi Delta-Fan, as a unit of alluvium, has a larger area of paddy fields planted to winter crops than any other of the larger alluvial lowlands, forty per cent of the rice land of Shida Gun, which includes most of the Oi Plain, being fall sown to barley, rye and wheat. It is significant that while for the whole prefecture barley occupies only fifty-nine per cent of the paddy area replanted to winter grains, on the Oi Delta-Fan where stony porous soils are prevalent, its percentage is seventy-eight. Some rape and genge are also grown which are not included in the above figure. Crossing this plain on December 14, enroute from Hamamatsu to Tokyo, the writer's field notes contain the following comment: "Instead of the apparent lifelessness of that plain (the Ota) this region is all activity—alive with people preparing and tending the fields with winter crops." This region therefore exhibits very chameleon-like variations in the colors and patterns of its seasonal landscapes. One could reasonably suppose that the general scattering of dwellings over the delta-fan might interfere with efficient drainage of the paddies, but if it does tend to complicate the irrigation and drainage canal systems this handicap is offset by the adequate and regular seaward slope of the fan, normally about eight feet per mile, in conjunction with the porous sandy and gravelly loam soils with gravel subsoils.

Toward the inner margins of the delta-fan, where danger from the Oi's floods is less likely, are Kanaya, Shimada, and Fujieda, three elongated but nevertheless compact small cities, strung out along the Tokkaido Highway, serving as collecting and distributing centers for the products of mountains, foothills and plains between which regions they stand in an intermediate and strategic position. Fujieda is the only one of the three cities which is not on the Tokkaido Railway but this handicap is partially overcome through the service of a private narrow gauge spur line which connects it with the main line. Kanaya, on the west side of the Oi, and just at the base of Makinohara, has become an important focus of tea trading, processing and distributing. Strategically adjacent to the great tea gardens of Makinohara and possessed of the best in the way of rail and highway facilities, this specialization seems quite natural. The citizens of Kanaya, it is said, have come to own much of the tea land on the nearby upland.

Shimada, across the river from Kanaya, has acquired some degree of fame as a sawmill center. Logs floated down the Oi from the mountains are taken from the river at this point, where they are processed into various lumber products. Piles of logs

along the banks of the river, and carloads of lumber and bark at the railway station, give even the transient visitor a clew as to one of the city's chief interests.

Shizuoka Prefecture, as noted in an earlier section of the paper, is, after Hokkaido, the ranking prefecture in the value of its fish and fish products, with the Oi Delta coast as the major center within the political province. One may localize the fame even more, for Yaizu, a small coastal city in the extreme northeastern part of the Oi Plain, has become almost nationally famous as a fishing and fish-processing center. In this development, as in so many others, Shizuoka is a sample of a condition which is typical for large sections of the Japanese coast lands, for fishing is not peculiar to this particular section. As one scans the data showing the value of fish products by prefectures, he is struck by the fact that they are, nearly all of them, fish producers of some consequence, 33 out of the 47 reporting fish catches valued at over 2,000,000 yen.[66] Poor in natural resources, lacking in animal foods, with an extraordinarily large population and most of it settled on small plains close to sea waters which are populated with marine life in moderate abundance, it seems only natural that fishing should, wherever it is possible, become an important adjunct to the economy of the seacoast populations. Along almost the entire coast of Suruga Bay, where because of the lack of a wide and formidable belt of sand and sanddunes, such as handicap the Enshu Coast, villages can occupy desirable beach ridge sites very close to the water's edge, fishing, and in some localities the manufacture of fish products, are well established. The relatively quiet waters of Suruga Bay reduce the physical difficulties and hazards of small boat fishing and at the same time the Bay's waters are abundantly populated with fish. Almost in the very center of Suruga Bay and just opposite the Oi Delta coast is a shallows known as the "Dogger Bank," a namesake no doubt of that famous fishing bank in the North Sea, and with a local reputation as a feeding grounds for marine life. It is not unlikely that the proximity of the bank to the Oi Delta section of Shizuoka may have been one element of situation, advantageous in the development of that region, as a fishing center. Numerous and sundry kinds of fish are included in the catch but bonito, yellow tails, and mackerel predominate. A considerable part of the catch is sold in fresh

[66] *Annual Report of the Department of Agriculture and Forestry*, 1925 (In Japanese), table 50, p. 156.

TABLE II. VALUE OF MARINE PRODUCTION IN SHIZUOKA PREFECTURE, IN YEN.[67]

Gun	Fish Products (fresh)			Processed Products			Total
	Coastal Fishing	Deep Sea Fishing	Aquiculture	Dried Fish	Canned Fish and other forms	Manure	
Sunto	368,073	10,000	2,500	251.455	103,850	....	735,878
Fuji	298,322	....	183	10,500	106,998	....	416,003
Ambara	1,324,822	20,146	264	457,694	2,304,405	....	4,107,531
Abe	211,351	436,810	2,880	198,900	126,022	500	976,463
Shida	1,205,806	3,840,310	42,352	2,390,912	1,591,562	25,507	9,096,449
Haruhara	1,107,539	1,258,337	40,753	737,720	118,750	5,650	3,268,749
Kogasa	55,730	....	....	560	24,172	3,600	84,062
Shuchi	20,245	....	370	....	990	....	21,605
Banden	234,100	159,789	127,871	72,292	10,337	...	604,389
Hamana	1,570,265	....	961,188	129,670	375,353	8,800	3,045,276
Hikisa	61,619	....	72,142	....	4,200	....	137,961
Shizuoka City	....	....	....	16,800	451,820	....	468,620
Hamamatsu City	....	....	....	....	50,500	....	50,500
Numadzu City	488,253	466,000	....	386,140	191,331	1,608	1,533,332
Shimizu City	276,725	50,550	45,227	137,703	104,649	....	614,854

[67] *Annual Census for Shizuoka Prefecture* 1925 (In Japanese), table 155, p. 161.

form but the drying and canning of fish has become a relatively large and specialized industry in Yaizu.

d. *Plains of the Enshu Coast*

The alluvial plains along that section of the coast known as Enshu, from Cape Omae westward, which face the more turbulent waves and winds of the open Pacific, are under the handicap of being separated from the sea by a wide, formidable and barren strip of sand and sand dunes. The coast is smooth and harborless; fishing is relatively less important than in Suruga Bay; coastal trade does not exist, and suitable sites for villages are to be found only at some distance back from the sea margin, not a single settlement along this coast being closer than half a mile from the water's edge, while in certain sections this is expanded to a mile or more.

A number of small streams trickle down on the south side of the prong of Tertiary mountain and diluvial terrace known as Makinohara, breaking through the irregular mile wide sand belt to the sea. The alluvial floored valleys of these creeks carry fingers of paddy culture for several miles back into the hills. The lower slopes of the bordering foothills, just at the point where they make contact with the alluvium, are the sites for rural villages, while other similar locations have been reclaimed from their natural tree and grass coverings and planted in the usual crops of vegetables, winter grains and tea. The outer half mile or so of the sand belt is bare wasteland without vegetation, but with increasing tree and grass cover toward the landward side where some vegetable and rice culture prevails although it is very patchy.

The Kiku River, which is the first stream of any consequence on the Enshu Coast west of Cape Omae, has a perfect dentritic valley system, alluvial floored, which it has carved out of the Tertiary and diluvial hills. A common feature of the landscape is the frequent artificial ponds formed by constructing earthen dams across the lower parts of the numerous small valleys and gulleys in the adjacent slope lands. This prevalence of pond irrigation would seem to indicate an insufficient supply of irrigation water from the dike protected Kiku and its tributaries and therefore the necessity of developing auxiliary sources of water supply. The plain and the bordering slopes are thickly studded with villages while there is a very concentrated east-west line of towns along the road which follows the inner margin of the sand belt.

The Ota Valley, next to the west, and separated from the Tenryu by Bandenohara terrace, is very much a duplication of the Kiku Valley but on a larger scale. Pond irrigation is here likewise practiced in the tributary valleys although scarcely to the same extent that it is in the Kiku Valley. The paddies are for the most part fallow during the winter, autumn-sown crops, with the exception of genge, being almost entirely absent. Bordering the rivers inside the dikes, as well as along the sandy outer margins of the plain, mulberry is a distinctive crop. Narrow gauge private railways, tributary to the main Tokkaido Line, serve both the Kiku and Ota Valleys.

The Tenryu Plain.—To avoid unnecessary repetition let it be said that the Tenryu Plain in general natural landscape forms is essentially like other alluvial areas in Shizuoka, viz., a flat surface with somewhat more elevated sandy outer margins, crossed from north to south by a braided and diked master stream. Confined as it is between the Mikatagahara and Bandenohara terraces, formerly continuous across the present six to eight-mile-wide valley, the Tenryu Plain is less distinctly fan or delta shaped except in its lower part where it extends beyond the terraces. As a graded stream the Tenryu has wandered frequently across its flood plain, cutting first against one terrace and then against the other, leaving relics of these attacks in the steepened sides of the uplands and in places secondary terrace benches and crescentic meander scarps somewhat above the present plain level. Even on the plain itself scars of a formerly vagrant river or some of its distributaries, still persist, minor relief features, soils and culture patterns in oxbow formations marking the earlier positions of meander curves. In the northern part of the plain west of the river there are several square miles of terrace material, which by lateral river erosion have been reduced to such a level and monotony of surface that it is scarcely distinguishable in relief from the rest of the plain. In the color and quality of its materials, however, it distinctly belongs to the terraces and its slightly greater elevation, and perhaps its unlike soil as well, have been sufficiently significant elements of environment that man has chosen to allow these areas to produce unirrigated crops instead of rice, that almost exclusive grain crop of Japanese lowlands. Mulberry perhaps occupies a larger percentage of this low terrace area than any other type of vegetation cover, although there are numerous patches of tea, vegetables, and coniferous woodland. One can frequently distinguish the

diluvium from the alluvium by the change in culture before he is aware of any increase or decrease in elevation.

The Tenryu, like all of the other rivers of Shizuoka, is practically unnavigable except for shallow, flat-bottomed, poled scows, or rafts of logs. Futomoto, strategically situated at the extreme landward end of the alluvium, at the point where the river debouches from its narrow mountain valley out onto the plain, has become a relatively important sawing center. Down to this point there has been no diversion of water for irrigation purposes so that log transport is not hindered even during the summer season. Tenryu Station on the west bank of the river, at the point where the Tokkaido Highway crosses the stream, and close to the railway as well, has become an important log, lumber, and general forest products collecting depot. The sloping banks or dikes are piled high with logs, lumber, bundles of splitwood, bark, twigs, charcoal, etc., while numerous ponderous scows are to be seen engaged in unloading their cargoes (Fig. 52).

Previously it has been stressed that the natural landscape forms of the Tenryu Plain are rather similar to those of the other delta-fans in Shizuoka. The culture pattern over relatively large parts is essentially distinctive, however, and cannot be duplicated in any other delta of the prefecture. The plain is two storied, with paddies occupying the lower floor and unirrigated crops the thousands of elevated patches which rise like small buttes, two to four feet high, above the lower inundated fields (Fig. 53). The plain reminds one of a huge checkerboard with rather irregular squares, great numbers of which have been pushed up above the general level of the board. These " buttes " are not of infrequent occurrence scattered here and there over the lowland as they are on other deltas; here they are so numerous that one almost wonders whether they do not occupy as much area as the paddies. It is not unlikely that they do in parts, especially near the river, but over the plain as a whole rice no doubt predominates. On the sandy and gravelly loams of the elevated patches the farmers, by means of intensive plant feeding and interculture, are able to grow three or four crops a year, summer vegetables and winter grains comprising the customary annual rotation. Rape, whose seeds yield an oil which is used in the rural homes as cooking grease, and is likewise sold as a commercial product, grows abundantly as a winter crop so that in April large areas of the Tenryu Plain are brilliant with the colors of the intermingled plots of dark green grains, yellow rape, and pink genge. The usual diversity

FIG. 52—Forest products depot at Tenryu Station on the Tenryu River.

FIG. 53—An elevated patch planted in mulberry rising above the paddy fields in the Tenryu Plain.

in summer vegetables prevails, with the addition of peanuts and ginger, this region supplying a very large proportion of the dried ginger of Japan. The paddies, except for the genge, are for the most part fallow during the winter. This reflects in part, drainage difficulties associated with the numerous elevated fields which complicate the canal systems; in part also the abundance of unirrigated crops from the " buttes " which make winter planting of the paddies less urgent. As on the Oi Delta-Fan, compact villages of fair size are relatively uncommon on the Tenryu Plain, there seeming to be a tendency, though not as marked as on the Oi Delta, to scatter the dwellings.

This peculiar and distinctive two-storied landscape of the Tenryu Flood Plain and Delta is likewise associated with a previously undiked river which wandered in a desultory fashion across its own alluvial deposits. Direct physical and cultural evidences of its vagrancies have previously been pointed out. The numerous raised patches are probably an indirect result of the same phenomena. According to an instructor in the secondary agricultural school at Nakizuma, and corroborated by interviews with farmers, the wanderings and floods perpetrated upon the plain by the Tenryu resulted in quantities of sand and gravel being poured out over the valuable paddy land. This catastrophe temporarily ruined the paddies for rice culture and clogged the canals, but with much labor the farmers removed the coarse, infertile detritus from the canals and fields. This material was usually piled up into heaps which probably at a later period were leveled off and planted in crops. As a corollary to the previous explanation it might be added that subsequent inundations found the raised fields suffering much less than the paddies, which may have provoked the farmers into creating more dry fields, or perpetuating those already formed. It is significant to note that the greatest development of elevated dry fields is in those regions fairly adjacent to the river where the flood menace would naturally be greatest, and that it does not exist at some distance back from the channel.

The Narrow Plain South of Mikatagahara.—Westward toward Hamana Lake from the Tenryu Delta and bordering Mikatagahara on the south, is a narrow sandy plain containing two low parallel beach ridges with intervening filled, or nearly filled lagoons and bordered on its sea margin by a chain of dunes twenty to forty feet high. A few dilapidated fishermen's huts and clumsy wooden boats are the only cultural forms along this desolate,

Saharan coastal belt. Immediately back of the belt of dunes which is 400 to 500 yards wide, is a double or triple system of sand ridges, six to ten feet high and doubly as wide, capped with coniferous trees. These ridge are artificial in the sense that they have accumulated around rows of shrubbery planted to prevent the wind-blown sand from migrating landward. The trees are a later development, no doubt grown with the idea of making the ridges permanent, ridges and trees together thus serving as wind and sand breaks for the villages and agricultural lands farther inland. The trees have a very marked leaning away from the sea, indicating the greater prevalence or strength of winds from that direction. Between the dunes and the first or outer tree-capped ridge, wasteland prevails, frequently with a bare sandfloor and only a little wiry grass scattered here and there. The second and third interridge basins are much more largely cultivated. The soil is scarcely less sandy but it is probably not so saline as in those sections nearer the sea. The ground water table is near the surface and some sickly looking paddy rice, unirrigated, is cultivated in the two inner troughs, but of more frequent occurrence are such crops as peanuts, vegetables, and mulberry, the last plants appearing thin and bearing few leaves. The rice plots are excavated somewhat below the general level of the basin floor in order to increase and make more certain their supply of water.

Inland from the last line of tree-capped ridges the narrow plain is a partially filled lagoon, wet and swampy in sections and with numerous fish ponds dotting the surface. Two low beach ridges traverse this plain, upon whose crests villages have been located, while the innermost one is followed by both the Tokkaido Highway and Railway. A third concentration of villages is apparent just at the base of Mikatagahara, from which position both pad-

FIG. 54—Geographic cross section from the sea coast west of Hamamatsu to the upland of Mikatagahara. (1) The Pacific Ocean; (2) The line of barren sanddunes; (3) Parallel sand ridges capped with conifers serving as sand and wind-breaks; (4) Lowlands planted in rice with numerous elevated patches of vegetables and mulberry; (5) Unirrigated beach ridges with villages and transportation lines; (6) Village at base of Mikatagahara; (7) Mikatagahara.

dies and uplands are easily accessible. The arrangement or distribution of crops on this lowland is intimately related to the soil and relief variations. Toward its seaward margins, and again on the old beach ridges where well drained sandy soils prevail and irrigation is difficult, rice is largely lacking and the usual vegetables together with peanuts and mulberry prevail. In the trough between the beach ridges, and between the inner beach ridge and the upland of Mikatagahara where the land is low and wet and soils are heavier with more humus, rice is the prevailing crop, but by no means the exclusive one for numerous elevated patches bearing mulberry and vegetables are common (Fig. 54).

Hamana Lake.—Hamana Lake, or perhaps more correctly, Hamana Lagoon, which marks the western boundary of the province is nationally famous as a center of aquiculture. Its particular fame has come through its eel nurseries, ranking second in the country in its annual shipments of live eels which are valued at nearly half a million dollars. The lake is very irregular in outline and is hemmed in on all sides by relatively steep walls of terrace or hard-rock material so that there is little room for nursery ponds except where tiny deltas are being formed at the heads of some of the narrow bays. Small nuclei of ponds occupy these

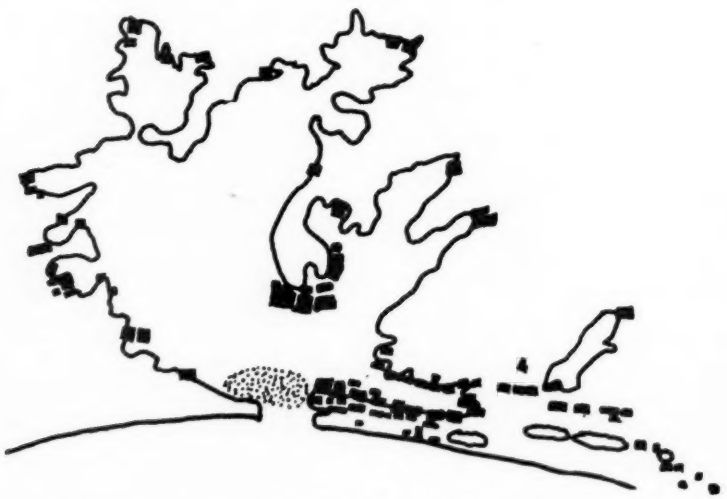

FIG. 55—Eel nursery ponds around Hamana Lake. The dotted area at the mouth of the lagoon represents the oyster beds.

positions at intervals around the whole perimeter of the lake, but the remarkable concentration occurs along the eastern arm of the lake which projects as a slender finger of unfilled lagoon back into one of the troughs of the narrow coastal plain south of Mikatagahara (Fig 55). Here there is much available low land, where excavation is easy and price of lands is low. The ponds vary considerably in size, from an acre or more in the case of the larger ones to those which are of tennis-court dimensions. All are provided with inlet and outlet systems which permit of filling and draining the ponds at will. Silver carp and turtles are of secondary interest to eels among some of the fish farmers.

The young eels, only a few inches long, are purchased by the nursery men from fishermen who seine them from the coastal waters and the rivers. Normally they are kept in the ponds and fed for a period of two years or so before they are considered to be of proper marketable size. Their food consists mainly of a tiny shrimp, seined in large quantities from the coastal waters, together with fish. During the summer months the dead pupae from the silk cocoons are an additional item of food. Eels are semi-amphibious in nature, so that it is possible to ship them alive to the city markets in wicker baskets, the latter having an upper compartment which is filled with ice so that the eels are kept cool and moist in transit by the ice water dripping down upon them from above.

The location of this specialized form of aquiculture on the shores of Hamana Lagoon reflects in a measure man's consciousness of favorable site conditions. The immediate vicinity is a natural breeding ground for eels so that the immature animals are obtainable in large quantities The salt water shrimp which is so important a food item for the hatchery eels is likewise abundant in the adjacent coastal waters and can be obtained for a longer period of the year than along many other sections of the coast. As has been previously noted, excavation for ponds is not difficult in the low marshy lands bordering the lagoon; land is inexpensive, and slightly brackish water for the ponds is available in large quantities from underground sources where the water table is nearly at the surface. With the ponds located along the margins of a navigable lake, it is an easy matter for small boats to collect eels from the scattered nurseries. Shipment is made to the metropolitan centers by means of fast express service on the adjacent Tokkaido Railway.

Although eels are the principal marine product from Hamana Lagoon, this inland body of water is an important fishing grounds as well, the little villages around its shores being semi-dependent upon fresh and dried fish as a source of income. In the shallow, semisalty waters just back of the narrow entrance into Hamana Lagoon is an oyster fishing ground. The ebb and flow of the tide cause a periodic movement of water past these beds bringing fresh supplies of food in the form of microscopic organisms for the oysters. There are no stifling deposits of silt at this location for the lake acts as a settling basin for the sediments brought in by the rivers. A sand bottom prevails and stones and gravels are artificially planted to serve as attachments for the larval oysters.

Bentenjima at the extreme western end of the eastern spit at the entrance to Hamana Lake has become a seaside pleasure resort of at least local prominence. Booths selling curios and gewgaws of all kinds, soft drink stands, and lunch counters all cater to the transient pleasure seekers, while a delightful beach and facilities for boating are added attractions.

Industrial Developments.—Hamamatsu, a city of over 100,000 people, and the adjacent villages of Hamana Gun in which the metropolis is located, are the third and most important center of manufacturing in Shizuoka Prefecture, the value of the industrial products, in 1925, from the gun and the city together, amounting to 82,000,000 yen or thirty-eight per cent of the total value of manufactured wares produced within the prefecture. A great variety of goods, including food products, silk and cotton yarns, woven goods, colored print goods, pianos and organs, bamboo and lacquer wares, hats and caps, bricks, mats, and metal goods are processed in the factories of the Hamamatsu district. For the most part the factories are small affairs and are not at all conspicuous in the landscape, a cotton spinning mill at Kitahama on the Tenryu Plain, several miles north of Hamamatsu, and a piano and organ factory within the latter city, being the only large-scale plants which the writer saw. The cotton spinning mill at Kitahama is a recent addition to the factories of the region. It is a modern plant utilizing electric power, with 32,000 spindles and 1000 employees,[68] housed in large modern buildings constructed of reinforced concrete and with adjacent dormitories for its em-

[68]Data obtained from manager of the factory.

ployees. Raw cotton from India and United States is brought to the door of the plant by a narrow gauge railway which serves this northwestern part of the valley. The general location of the plant, i.e., within the Hamamatsu district, is particularly strategic, according to the manager, because of the large local market for yarns provided by the numerous weaving mills which are concentrated within Hamana Gun. The piano and organ factory employing 1300 persons, and the hat and cap factory with 300 workers, are both old establishments with thirty years of operation to their credit.

Of overshadowing significance, however, is the weaving industry, its products contributing sixty-one per cent of the total value of manufactured wares produced in Hamamatsu City and Hamana Gun. The industry is peculiar and distinctive in that production is being carried on in a multitude of small and insignificant plants, some of them scarcely more pretentious than an unpainted implement shed on an American farm (Fig. 56). They are usually much more noticeable because of the clatter of the looms than for any physical characteristics which might distinguish them and set them apart from the surrounding buildings. Within the so-called Enshu district, which is comprised of the four western gun of Shizuoka prefecture, together with Hamamatsu City, there are

FIG. 56—A small cotton-weaving mill near Hamamatsu.

462 weaving factories employing over 10 workers and 1216 with less than 10 employees.[69] Much the greater share of these is concentrated within the so-called Hamamatsu district, on the lowlands bordering Mikatagahara on the east and south (Fig. 57). Approximately five-sevenths of the product of the looms is white and gray cotton cloth, generally cheap and inexpensive, and largely for home consumption although some is exported to China, India and the South Sea Islands.

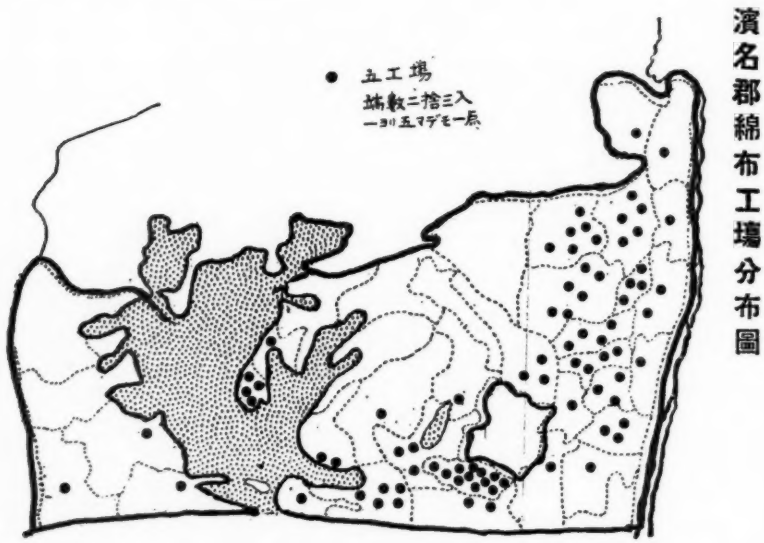

FIG. 57—Distribution of factories making cotton cloth within Hamana Gun (excluding Hamamatsu City). Each dot represents five factories. Taken from *Geography of Shizuoka Prefecture,* published by the Shizuoka Department of Education. Note: The factories here considered are those having more than 10 laborers.

This rather remarkable concentration of a large number of relatively small weaving establishments in the Hamamatsu region, giving Shizuoka Prefecture first place in total number of weaving plants, although it ranks only fifth in value of cotton fabrics, can be explained only by examining the historical antecedents of the industry. From individual factory managers as well as from The

[69]Data obtained at office of The Weavers Association of Shizuoka Ken in Hamamatsu.

Weavers Association in Hamamatsu, information was obtained to the effect that the present power-loom industry is the offspring of an earlier household industry forebear. Historical records show that there was a weaving house at Kakigawa in the Enshu district over a thousand years ago. The large expansion of the industry and the substitution of power for handlooms occurred at about the time of the World War and apparently had a dual genesis. At this time the foreign market for Japanese textiles increased markedly which offered an economic stimulus for expansion, while contemporaneous local hydroelectric developments made available a new and relatively inexpensive source of power. As far as the writer was able to learn, all of the power loom establishments use electric power and the information was repeatedly volunteered from a number of sources that it was this available and cheap power resource which had attracted industry to the Tenyru district.